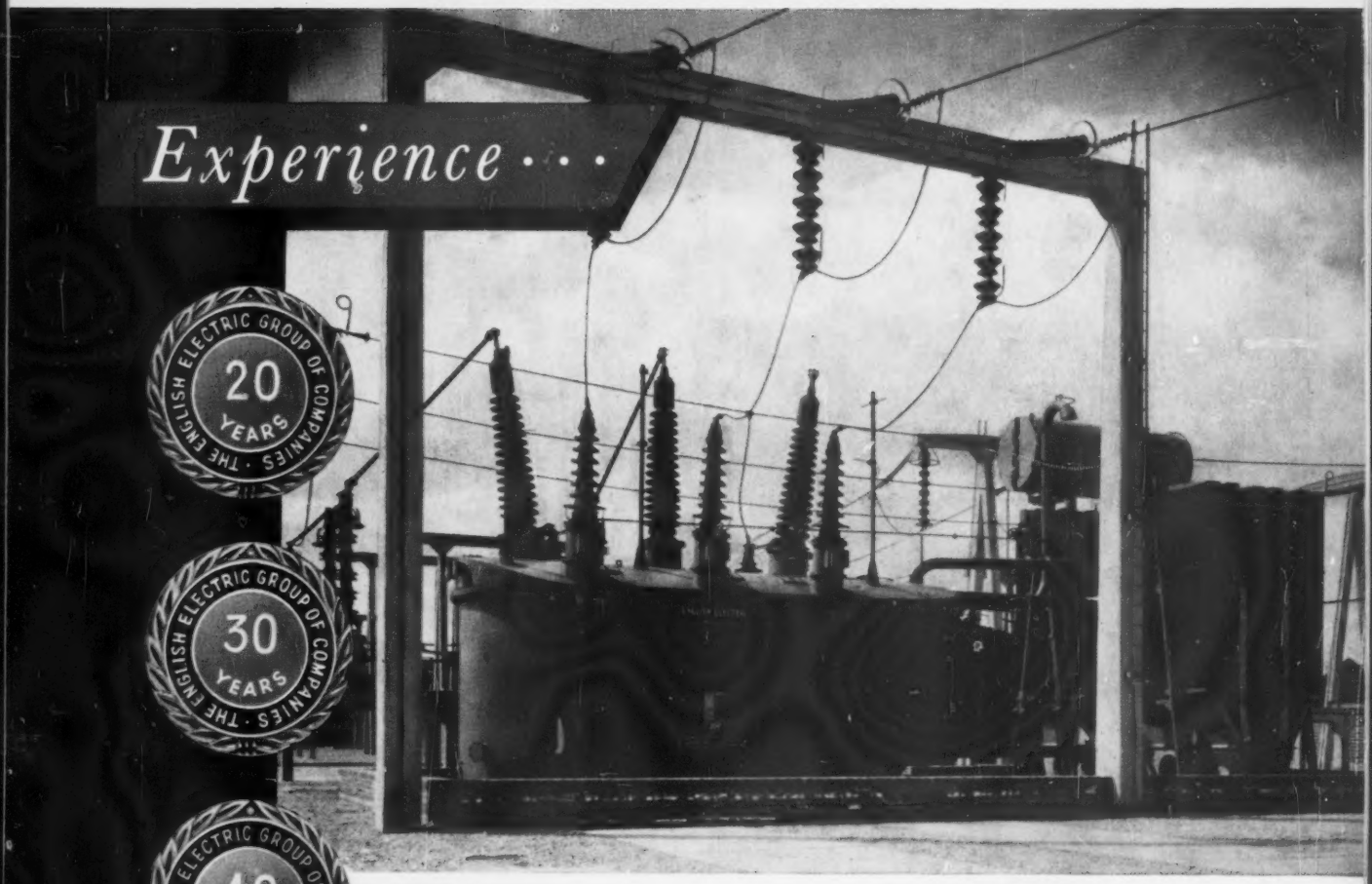
7 JANUARY 1960

ONE SHILLING
AND SIXPENCE

ELECTRICAL TIMES



These long-service medals were recently presented to men who design and build 'ENGLISH ELECTRIC' transformers. No less than 3750 man-years have been devoted by long-service employees in the advancement of

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transformers

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2
Transformer Department, Stafford
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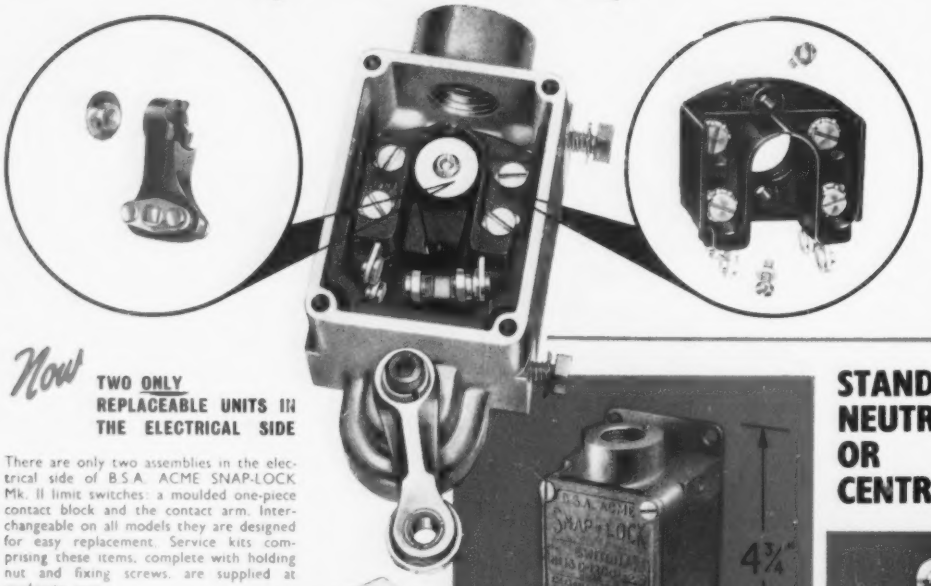
A TYPE APPLICABLE TO EVERY INDUSTRY

in Mark II SNAP-LOCK heavy duty limit switches



WATER
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DUSTPROOF
OR
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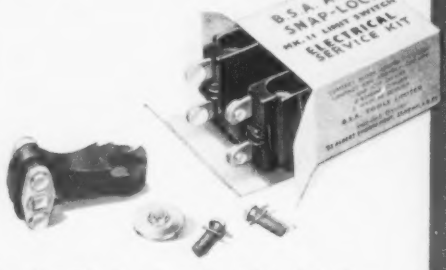
VERSIONS

Now **TWO ONLY REPLACEABLE UNITS IN THE ELECTRICAL SIDE**

There are only two assemblies in the electrical side of B.S.A. ACME SNAP-LOCK Mk. II limit switches: a moulded one-piece contact block and the contact arm. Interchangeable on all models they are designed for easy replacement. Service kits comprising these items, complete with holding nut and fixing screws, are supplied at moderate cost.



B.S.A. Acme Snap-Lock heavy duty limit switches have an established reputation for reliability under the most arduous conditions. Recently introduced Mark II versions retain proved features of their forerunners but incorporate refinements in design and manufacture principally to simplify servicing, provide complete interchangeability of assemblies, increase electrical resistance to earth and ensure lasting efficient sealing. Please ask for the Mark II catalogue.

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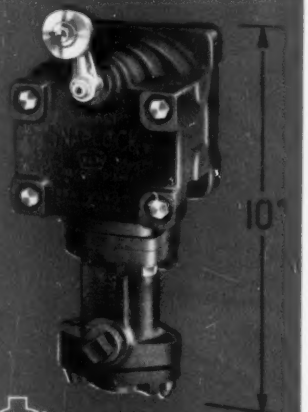
WATER, OIL & DUST PROOF

Single pole, double break, double throw, operates with either circuit normally open with other closed, or maintaining in either position, or available with central (neutral) position and/or centre connection. Heavy aluminium die-cast case. Water, oil and dust proof. Conduit ¾ in. B.S., or No. 3 Admiralty Pattern Cable gland entry. Two-screw side mounting or backplate mounting in two styles, or Tandem style (back to back mounting). Operating lever position adjustable in 7.5 deg. increments through 82.5 deg. either way from normal.

STANDARD NEUTRAL POSITION OR CENTRE CONNECTION



FLP FLAMEPROOF

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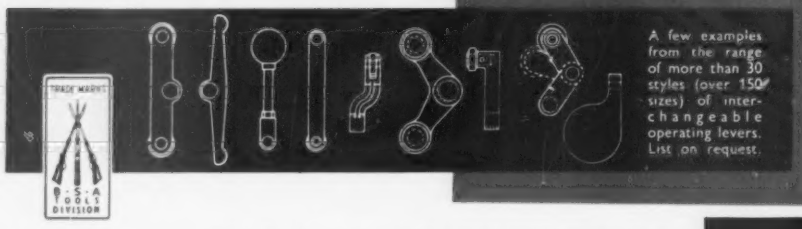
Buxton certificates No. 3574 (Group I) No. 3575 (Groups II and III gases). Meehanite iron castings. Self wiping solid silver contacts, interchangeable plugs and sockets. Internal mechanism removable as a unit for servicing. **Single SWA cable entry (standard); double entry if required.** *Operating lever position adjustable in 7.5 deg. increments through 360 degs. Single pole, double break, having one normally closed and one normally open circuit. Available with central (Neutral) position and/or centre connection.*



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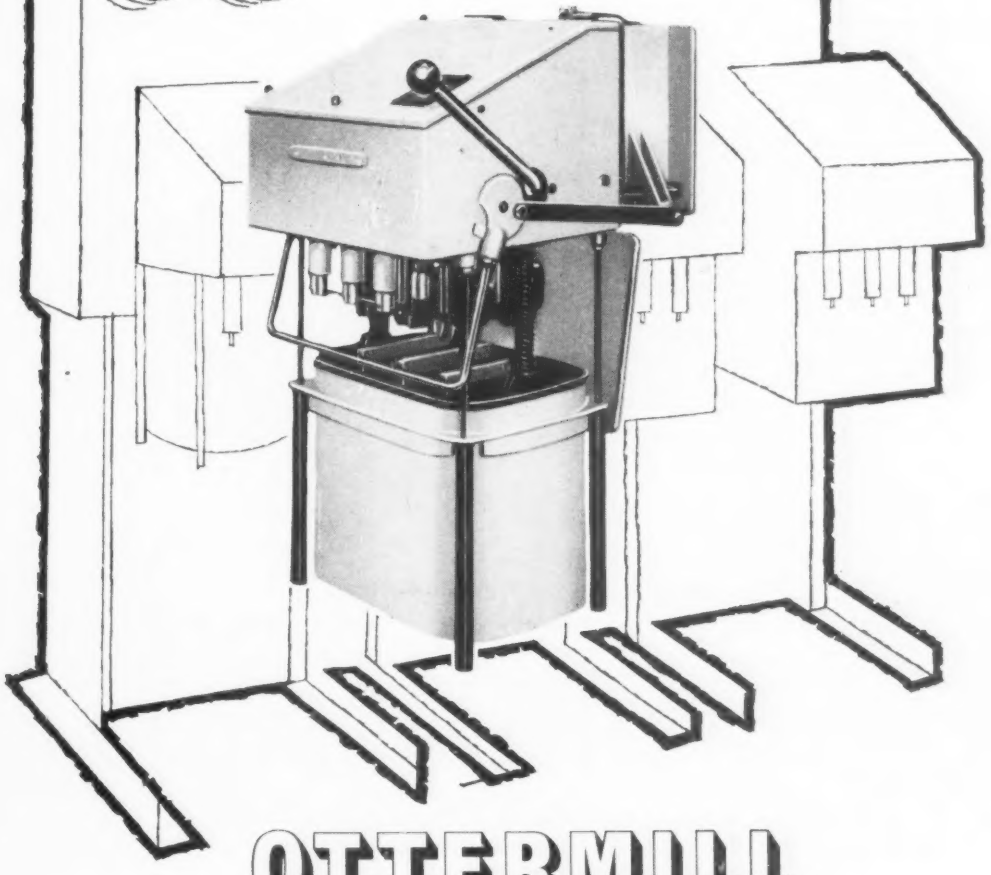
B.S.A. SNAP-LOCK ACME

A highly rated circuit breaker...



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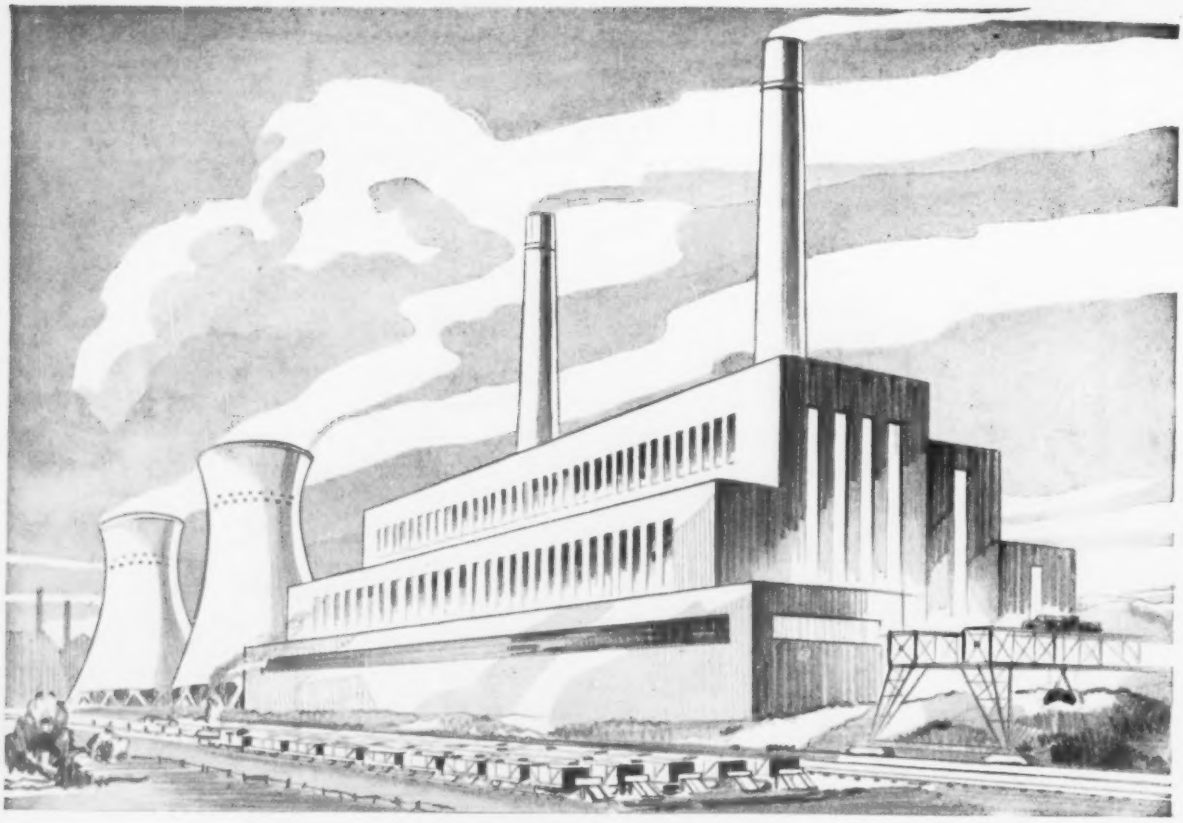

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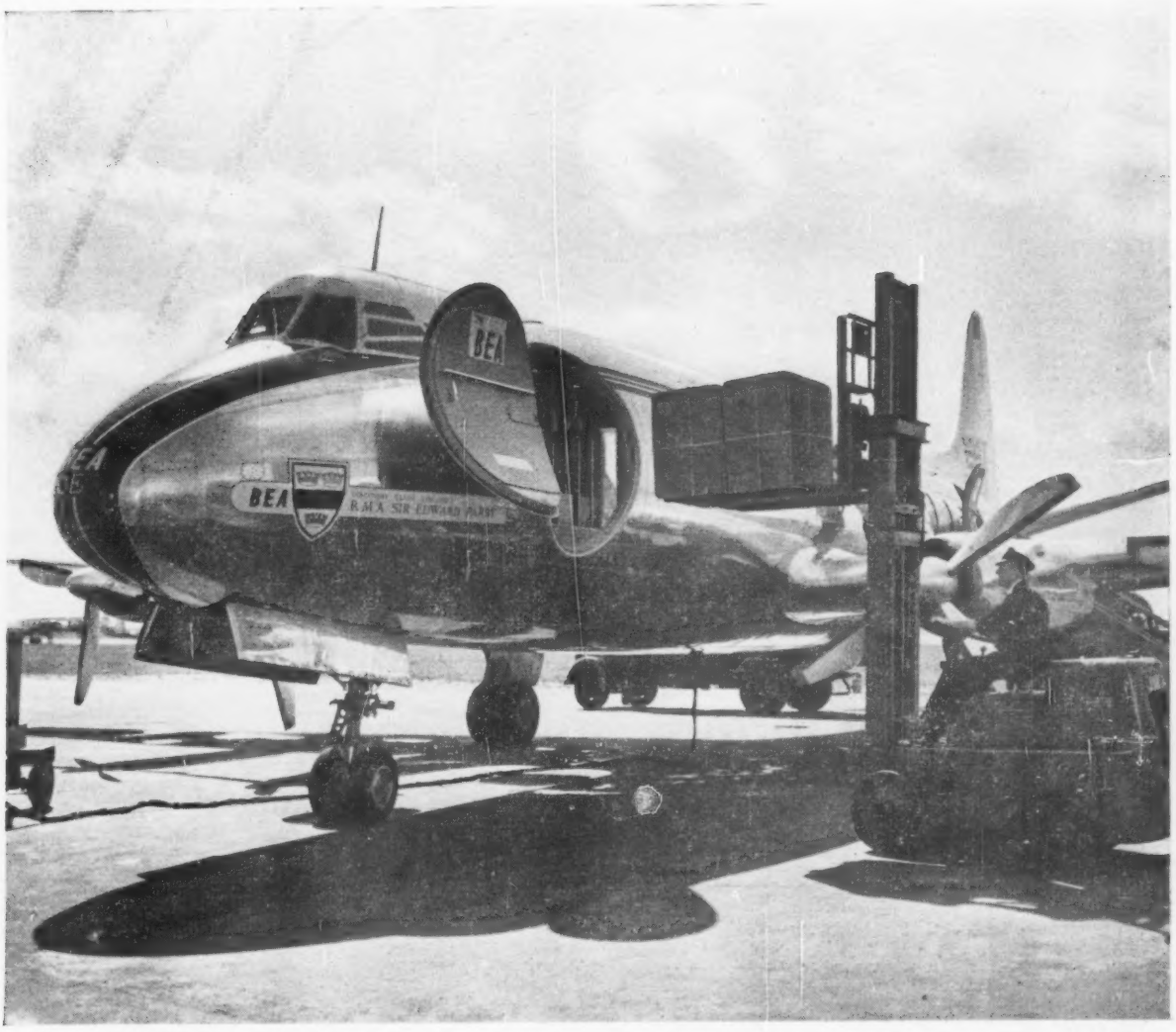

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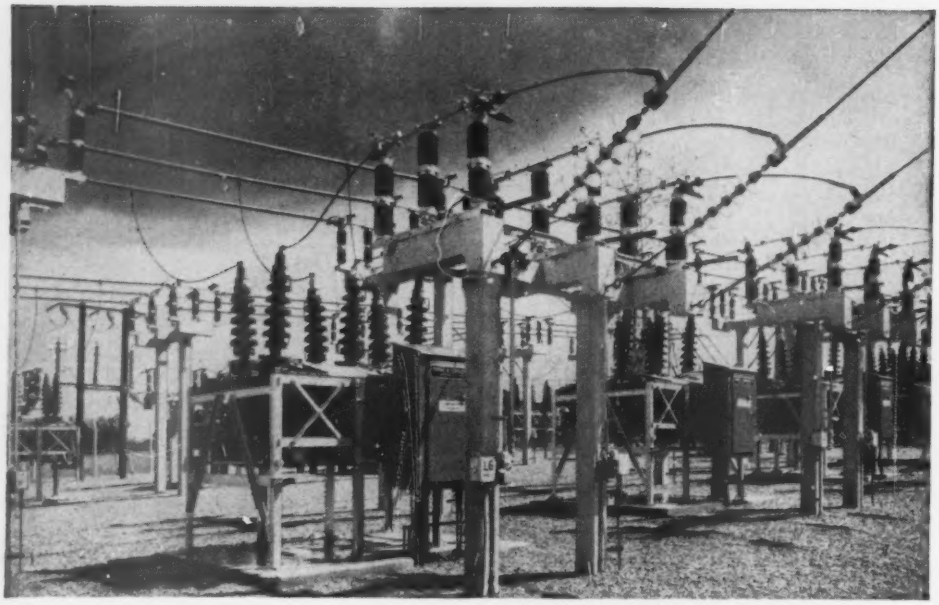

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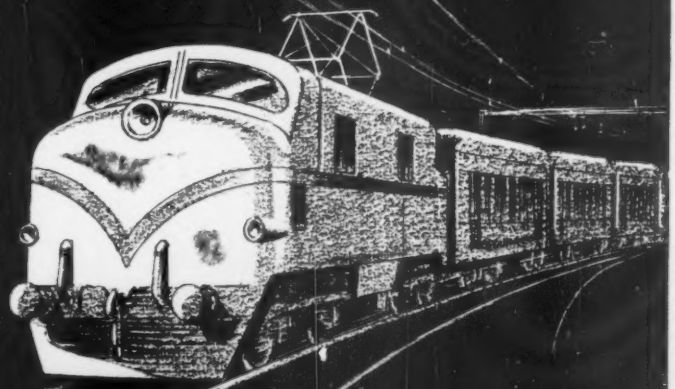

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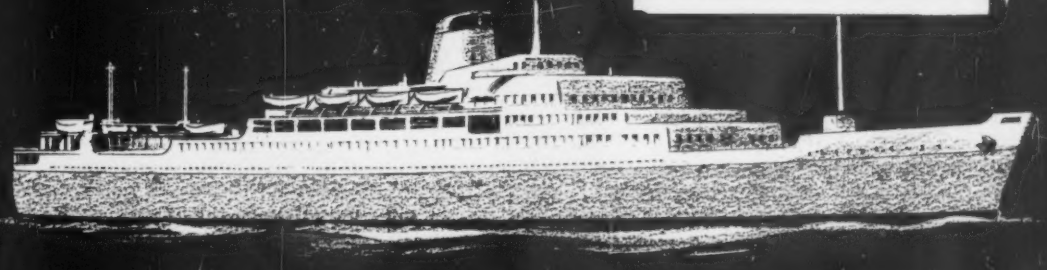

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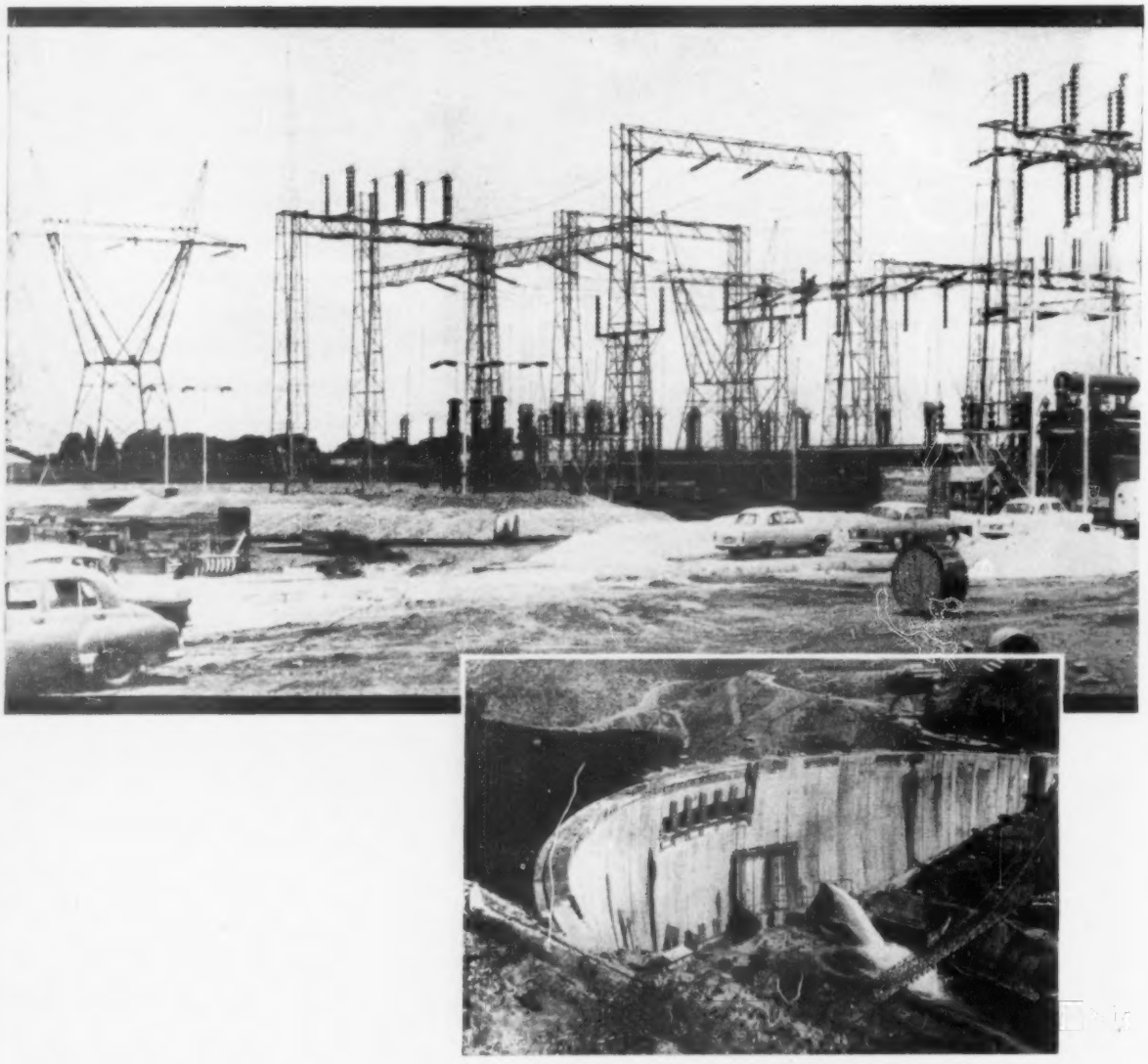
for Kariba...



Kariba Dam. (Photograph by courtesy of the Office of the High Commissioner for Rhodesia and Nyasaland.)

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cable by AEI

The 330 kV sub-station at Norton, Rhodesia.

For the giant Kariba hydro-electric scheme on the Zambesi River, Siemens Edison Swan have supplied high-quality cable manufactured at their Lydbrook and Woolwich works.

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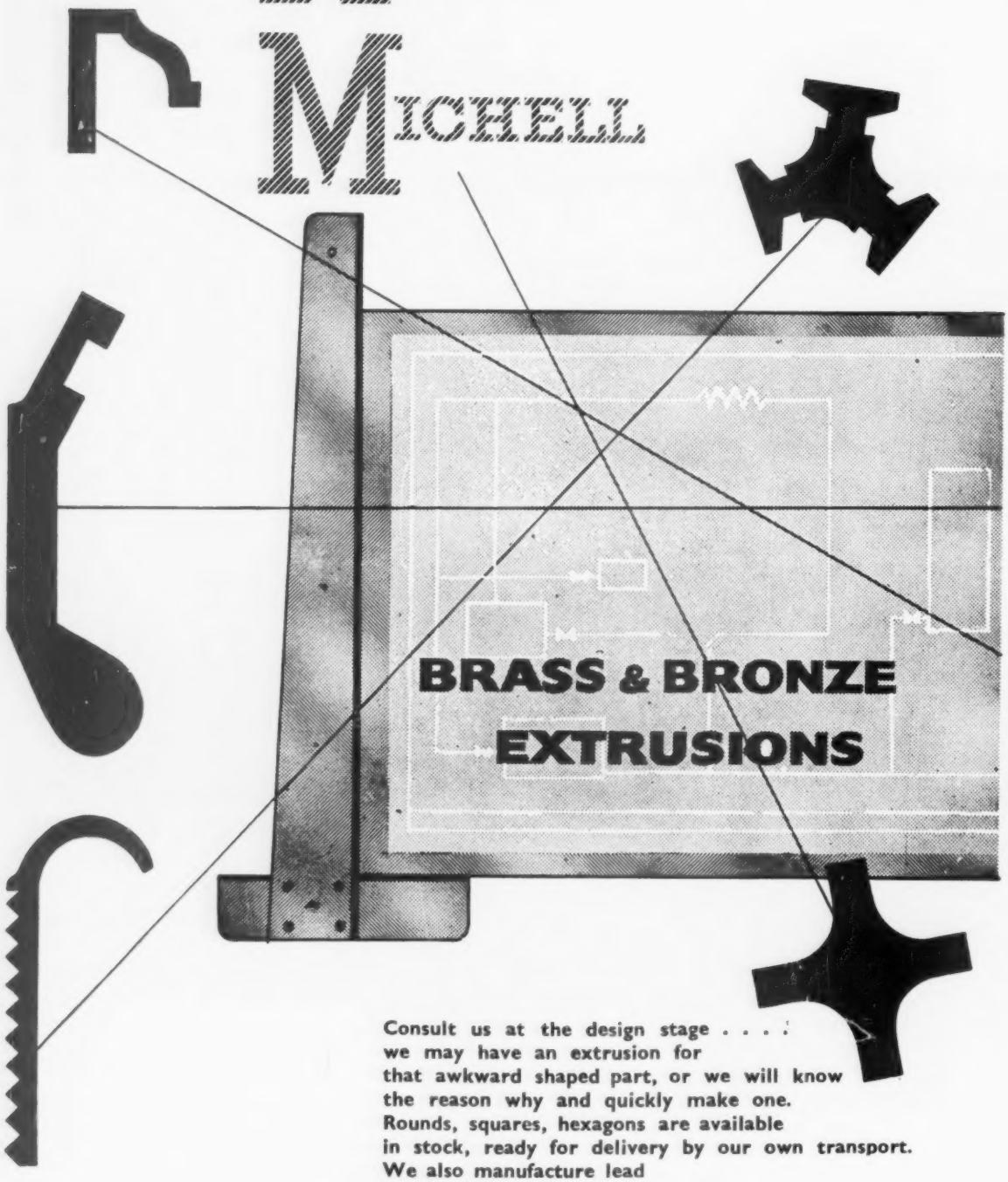

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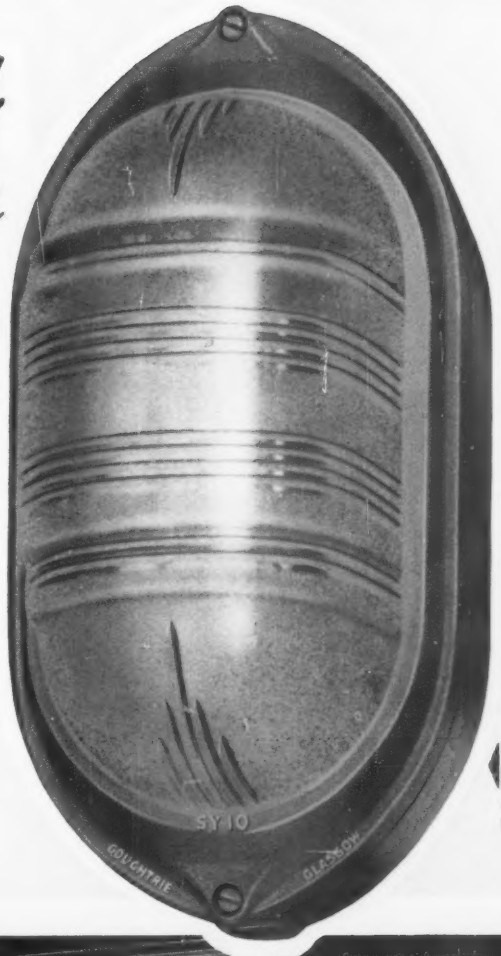

SY 10
100 WATTS
(or smaller size
SY6 *60 Watts)*

UNIQUE DESIGN INCLUDES THESE IMPORTANT FEATURES

- ★ *All fixing screws outside gasket*
- ★ *No external projections*
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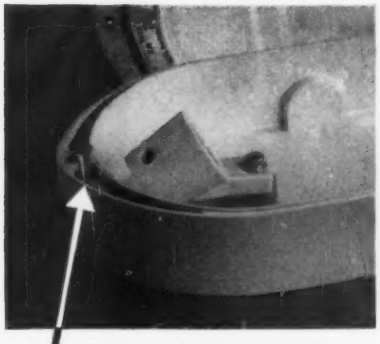
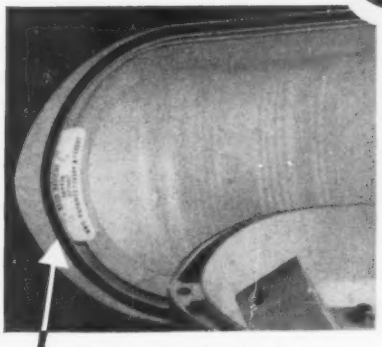


Patented double wall feature permits gasket to be placed inside fixing screws



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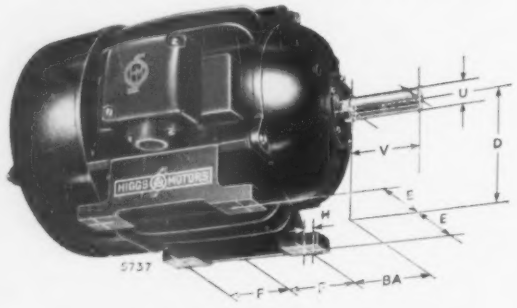

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2	1½	¾	½	D164	4	3⅜	2½	2⅜	⅜	⅜	2½	3/16	3/16	
3	2	1	¾	D182	4½	3½	2½	2⅜	7/16	1½	3	5/16	¼	
5	3	2&1½	1	D184	4½	3½	2½	2½	7/16	1½	3	5/16	¼	
7½	5	3	2&1½	D213	5½	4½	2½	3½	7/16	1⅝	3⅜	7/16	5/16	SHORTLY
10	7½	5	3	D215	5½	4½	3½	3½	7/16	1⅝	3⅜			
15	10	7½	5	D254	6½	5	4½	4½	9/16	1⅝	4⅜			
20	15	10	7½	D256	6½	5	5	4½	9/16	1⅝	4⅜	7/16	5/16	
25	20	—	10	D284	7	5½	4½	4½	9/16	1⅝	4⅜	7/16	5/16	
30	25	15	—	D286	7	5½	5½	4½	9/16	1⅝	5⅜		5/16	
	30	20	15	D324	8	6½	5½	5½	11/16	2⅛	6⅛		7/16	
	40	25	20	D326	8	6½	6	5½	11/16	2⅛	6⅛		7/16	

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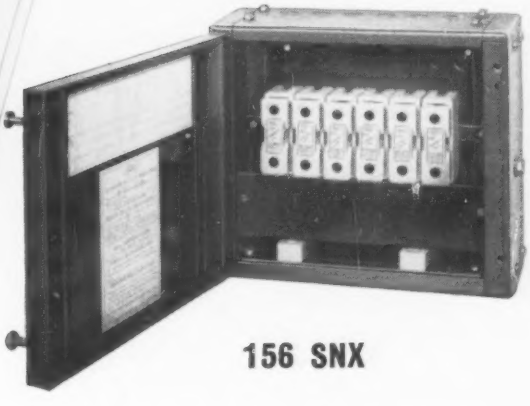

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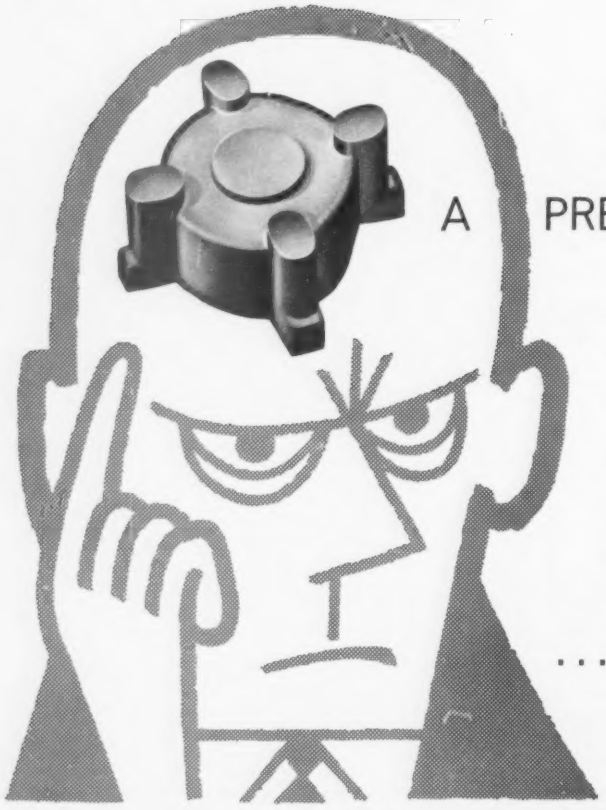

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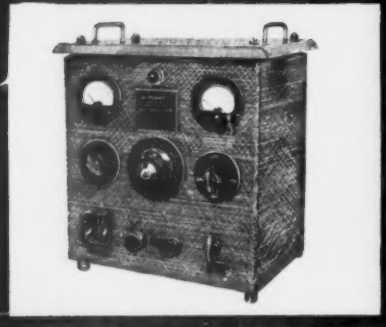

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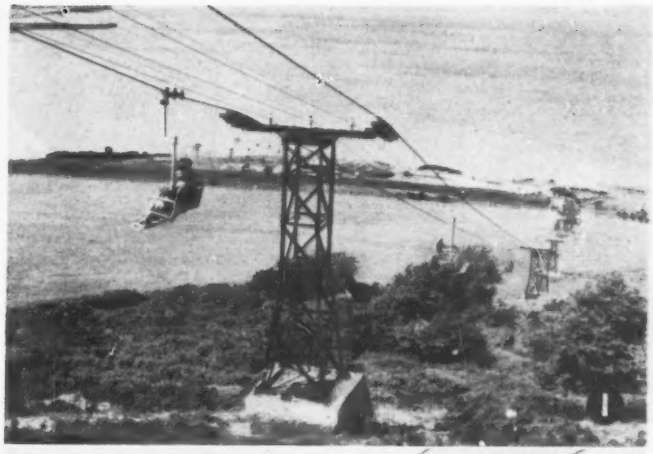
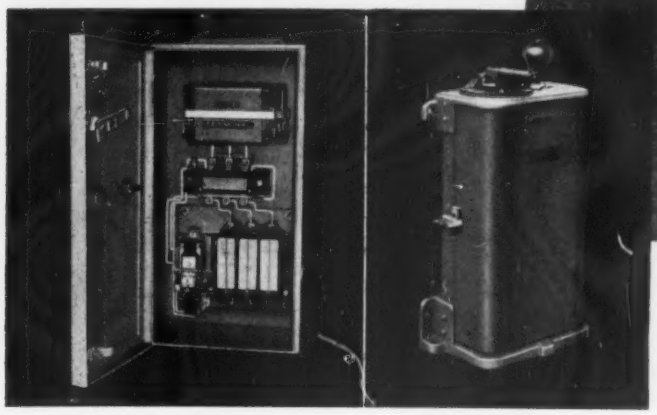
The safety of passengers is of paramount importance and both fixed clip and detachable grip chairlifts incorporate special brakes, overspeed protection and remote emergency stopping.

The control is arranged to enable the operator to accelerate and retard the line of carriages smoothly under all conditions of loading and provide; automatic protection against over-speeding when starting under regenerative conditions.



1. Chairlift at Bray in Eire.
2. At Butlin's Holiday Camp, Ayr.
3. At the Dudley Zoological Gardens.

(below left) EAC direct-on starter and (right) drum controller as used for chairlift control.



EAC are the ORIGINAL Singlephasing Preventor People

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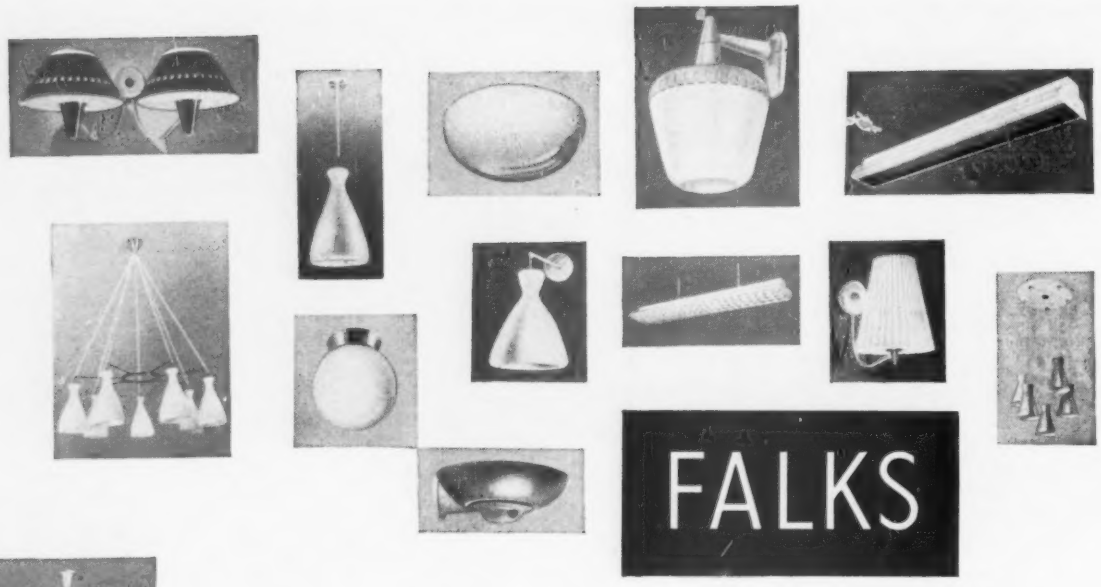

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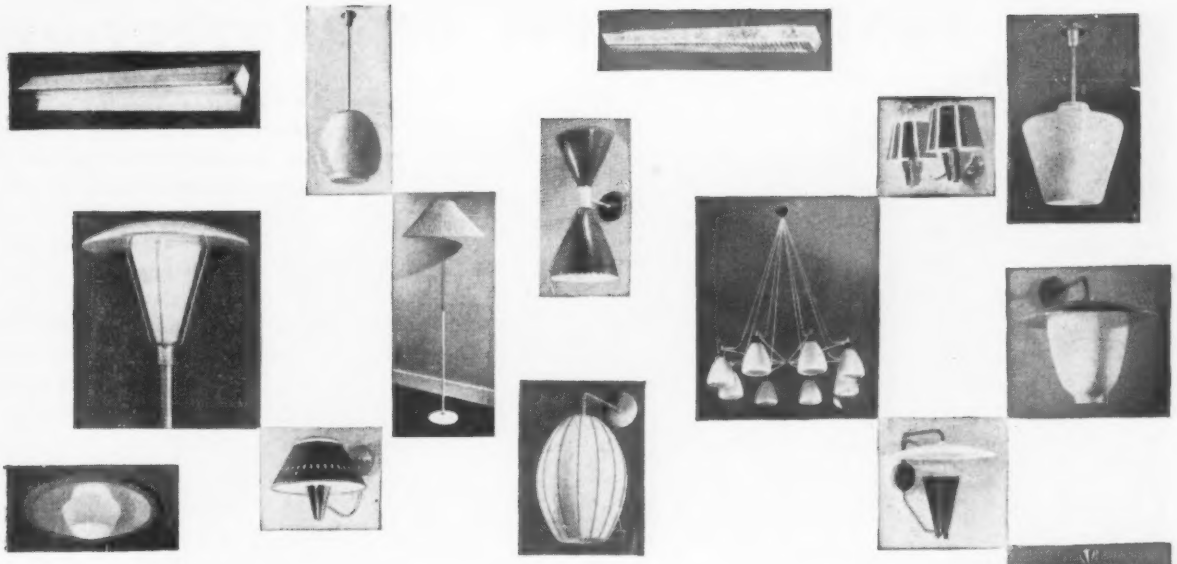
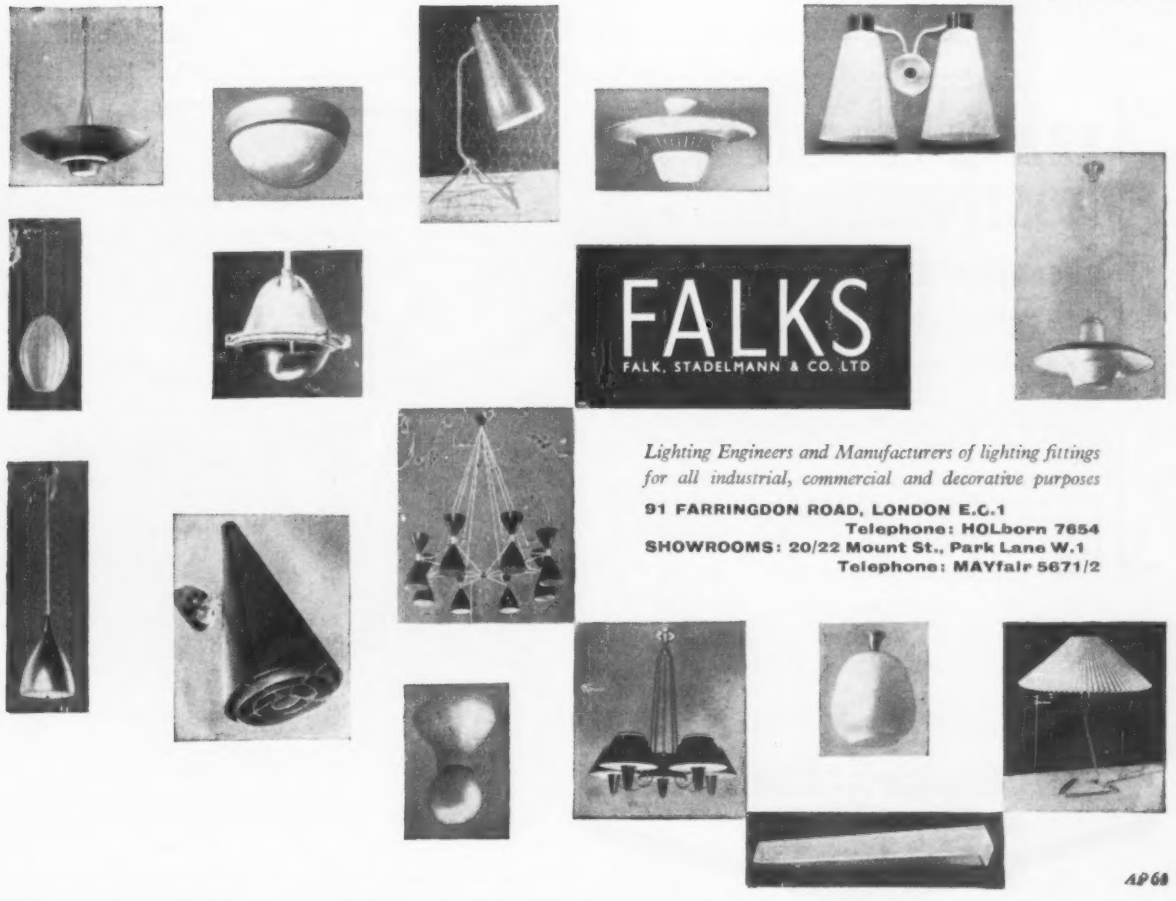


. . . industrial . . . commercial . . . domestic



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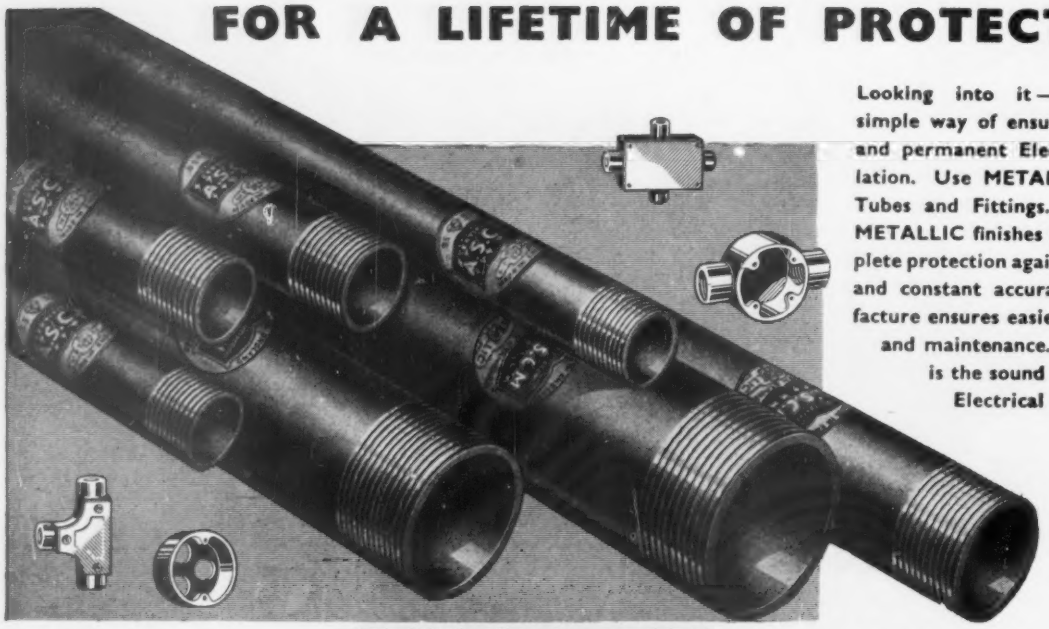
AP 68

FOR A LIFETIME OF PROTECTION



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ALSO AT LONDON, NEWCASTLE-ON-TYNE, LEEDS, SWANSEA & GLASGOW

EB

EARTH CIRCUIT MONITORING UNITS

offer greater protection to your portable equipment

A full range of Earth Circuit Monitoring Units is available, up to 200 amps, incorporating either Automatic Circuit Breakers or Contactors; the Units can also be arranged for tripping of remote Switchgear. Current Balance Earth Leakage Protection is incorporated when required.

Interlocked switch plug-sockets can be supplied, either incorporated in the Monitoring Unit, or mounted separately, which permit **the monitoring of a number of portable equipments from a single Monitoring Unit.**

All in sheet steel dustproof enclosures.

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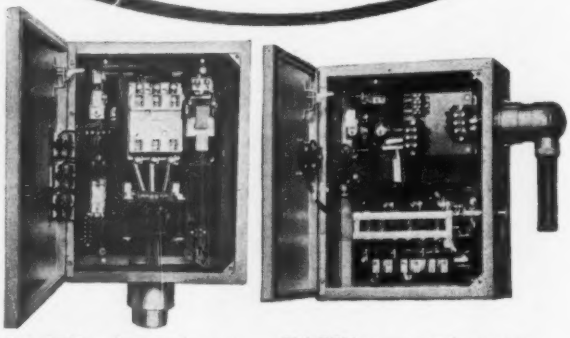
Read this
extract from the 1958 Annual Report of the Chief Inspector of Factories

"The most important conclusion to be drawn from this analysis, is that accidents caused by portable and transportable electrical apparatus and their associated cables and accessories formed the largest proportion of electrical accidents . . . In this field there is need for special effort to reduce accidents".



Unit CEM-50 incorporating a 50 amp Contactor with Earth Leakage Monitoring and Current Balance Earth Leakage Protection.

Unit BEM-30 incorporating a 30 amp Automatic Circuit Breaker, with Earth Circuit Monitoring and Current Balance Earth Leakage Protection.

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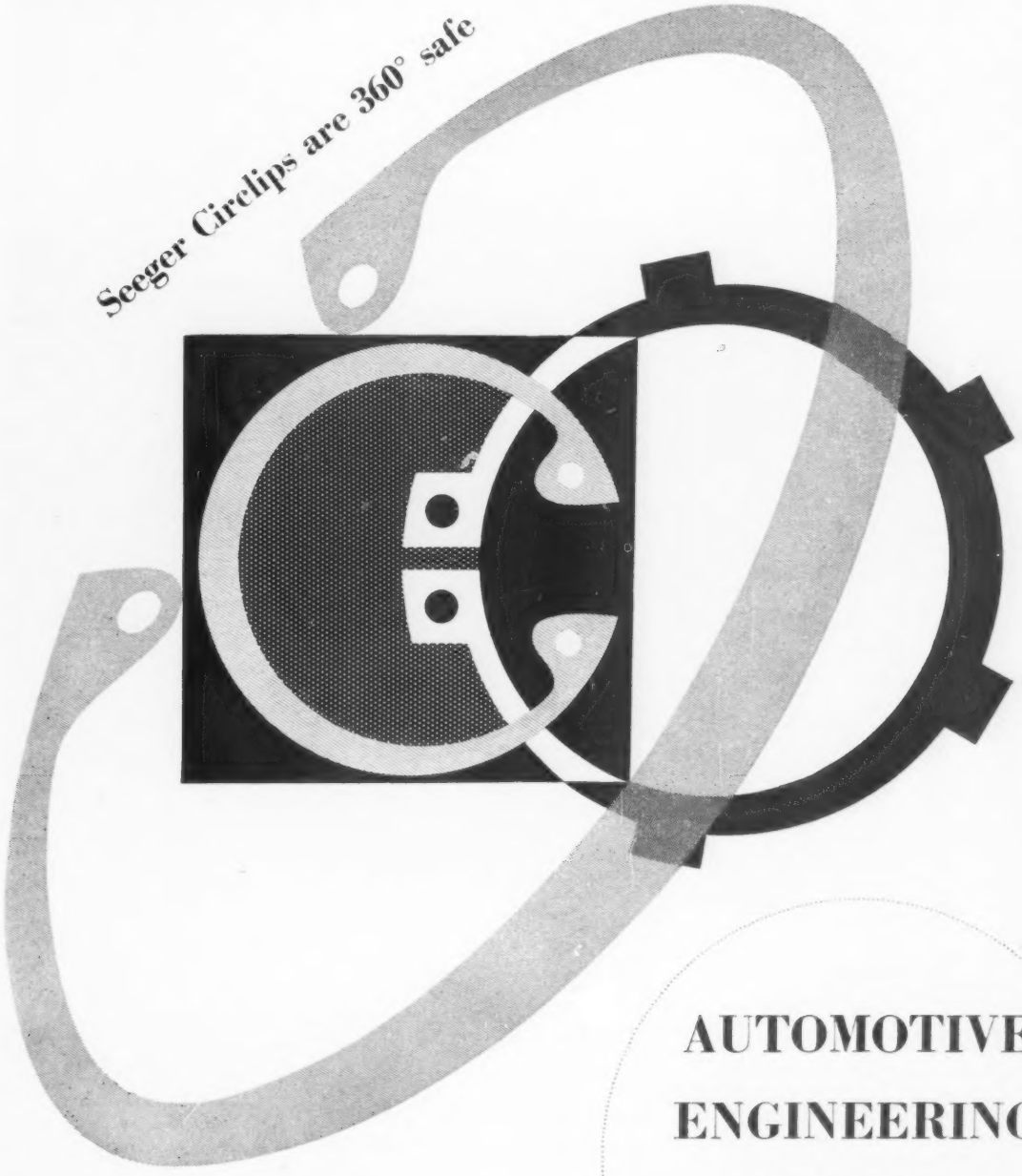

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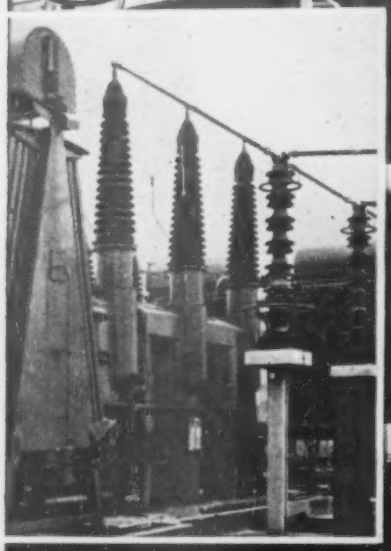
✳ Power in the making



✳ Transformers have been increased in size over the years to meet the demands dictated by the growth of power systems. Always during this time PARSONS have produced the larger types of transformers. In keeping with these developments PARSONS have installed manufacturing and testing plant to produce power transformers of the highest voltages and ratings.

The impulse test plant shown here with a 120 MVA transformer on test is rated at 2½ million volts at a stored energy of 60 kW secs.

The autoclave plant behind, used for vacuum drying and oil impregnating processes, is capable of fully enclosing the largest tank yet manufactured by PARSONS.

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POWER TRANSFORMERS
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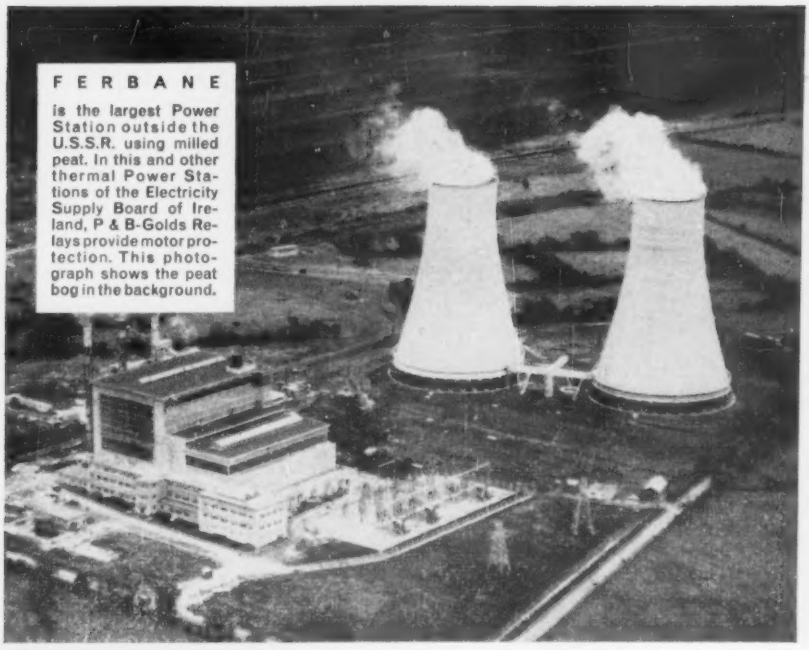
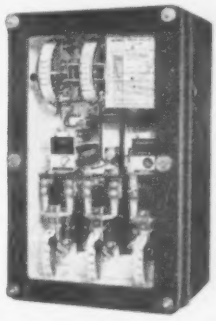


FERBANE
is the largest Power Station outside the U.S.S.R. using milled peat. In this and other thermal Power Stations of the Electricity Supply Board of Ireland, P & B-Golds Relays provide motor protection. This photograph shows the peat bog in the background.

BORD SOLATHAIR AN LEICTREACHAIS choose P & B Golds Relays

P & B Relays give full protection for motors with any starting periods or currents under extremes of ambient temperature.
P & B Golds Relays protect against phase failure, overload, short circuit or earth fault. P & B Stalli g Relays give complete protection against stalling under all conditions. Send for current literature.



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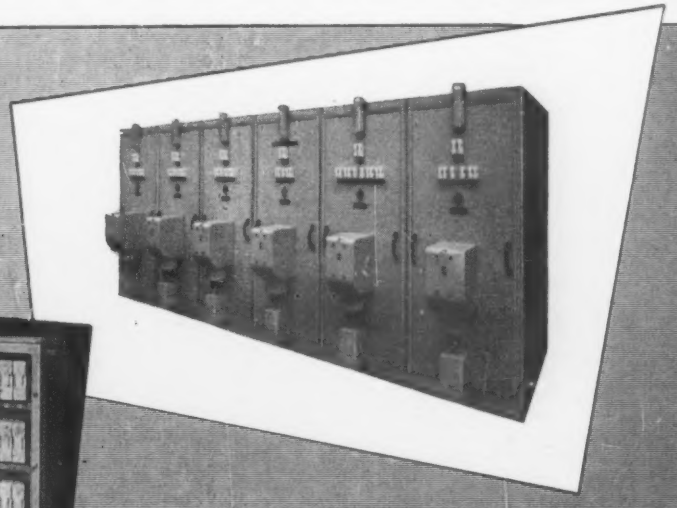

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Truck and cubicle switchboards up to 11 kV 250 MVA. A.S.T.A. certified oil circuit breakers. Remote control panels. Ring main units. Isolating switches. Unit type industrial switchgear. Ironclad distribution boards and switch fuses.

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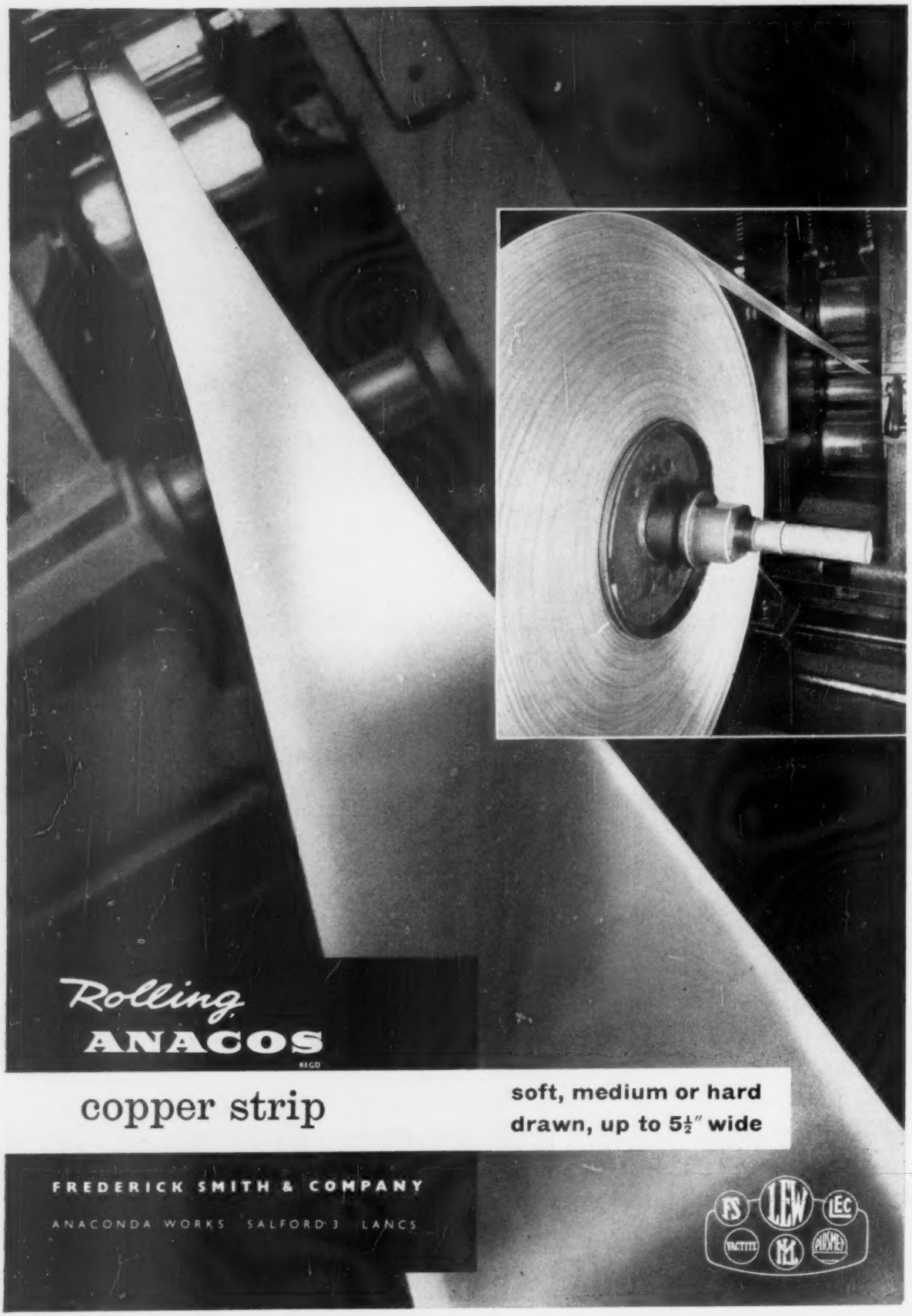
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NEWS SHEET

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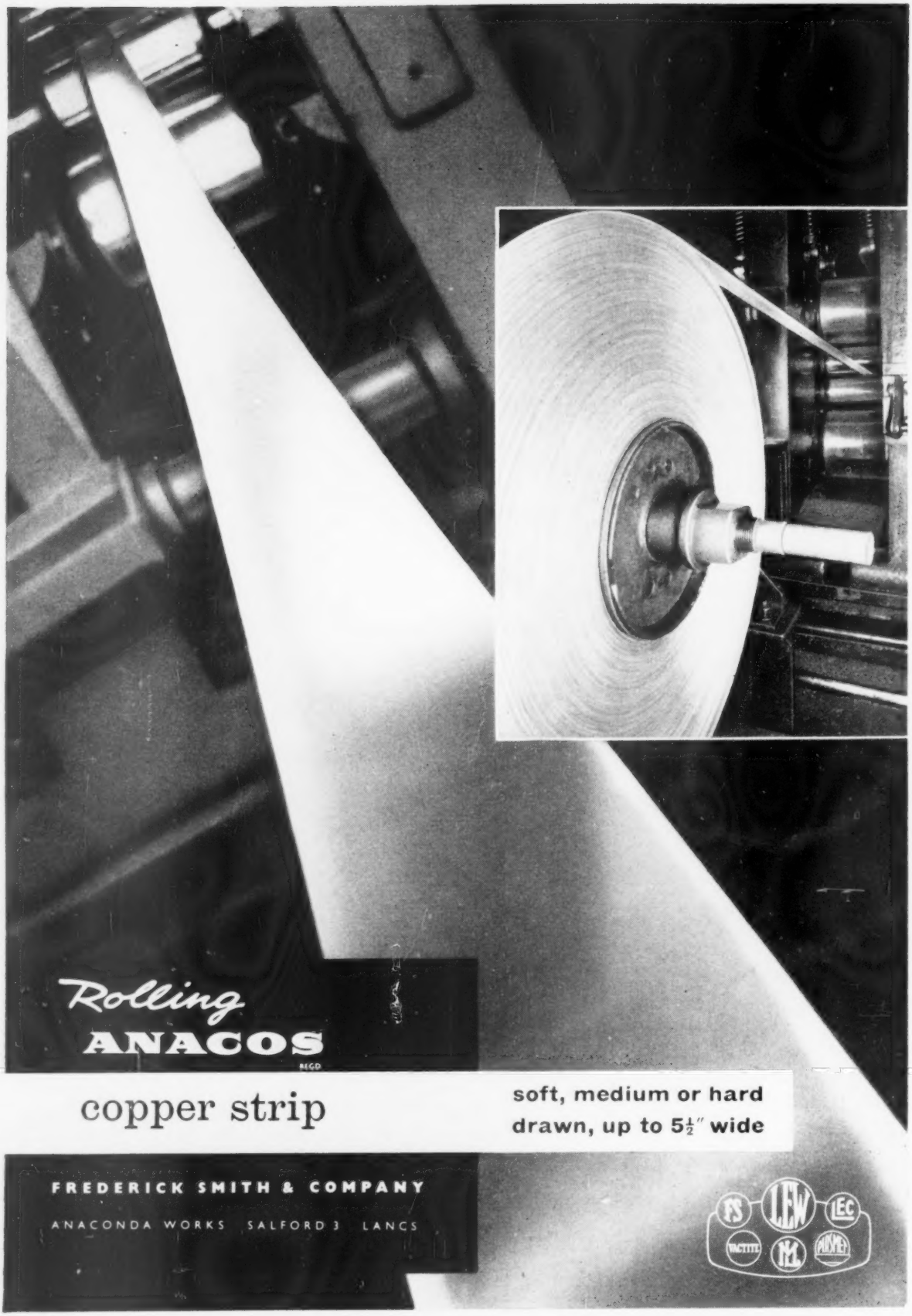
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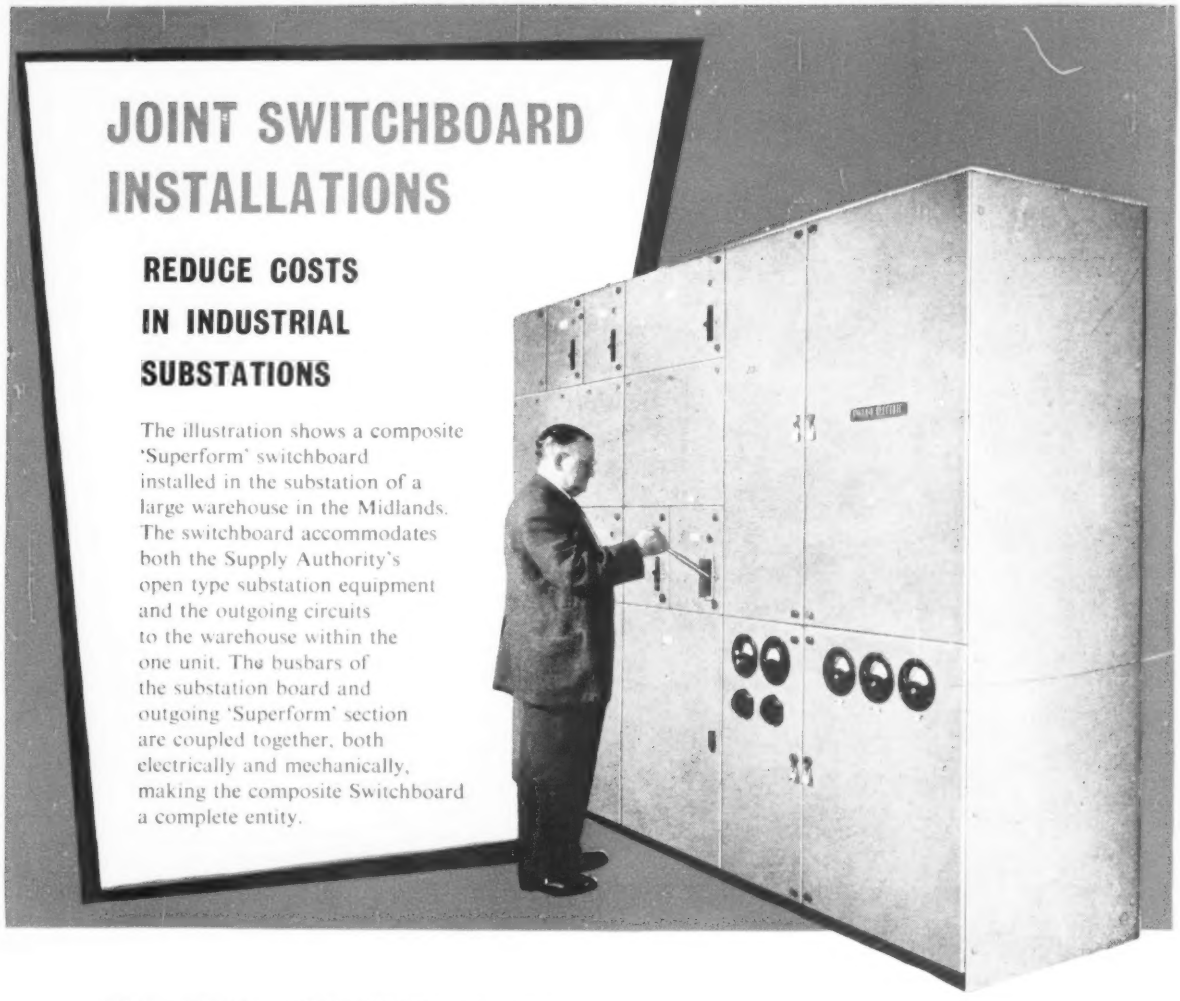
JOINT SWITCHBOARD INSTALLATIONS

REDUCE COSTS IN INDUSTRIAL SUBSTATIONS

The illustration shows a composite 'Superform' switchboard installed in the substation of a large warehouse in the Midlands. The switchboard accommodates both the Supply Authority's open type substation equipment and the outgoing circuits to the warehouse within the one unit. The busbars of the substation board and outgoing 'Superform' section are coupled together, both electrically and mechanically, making the composite Switchboard a complete entity.



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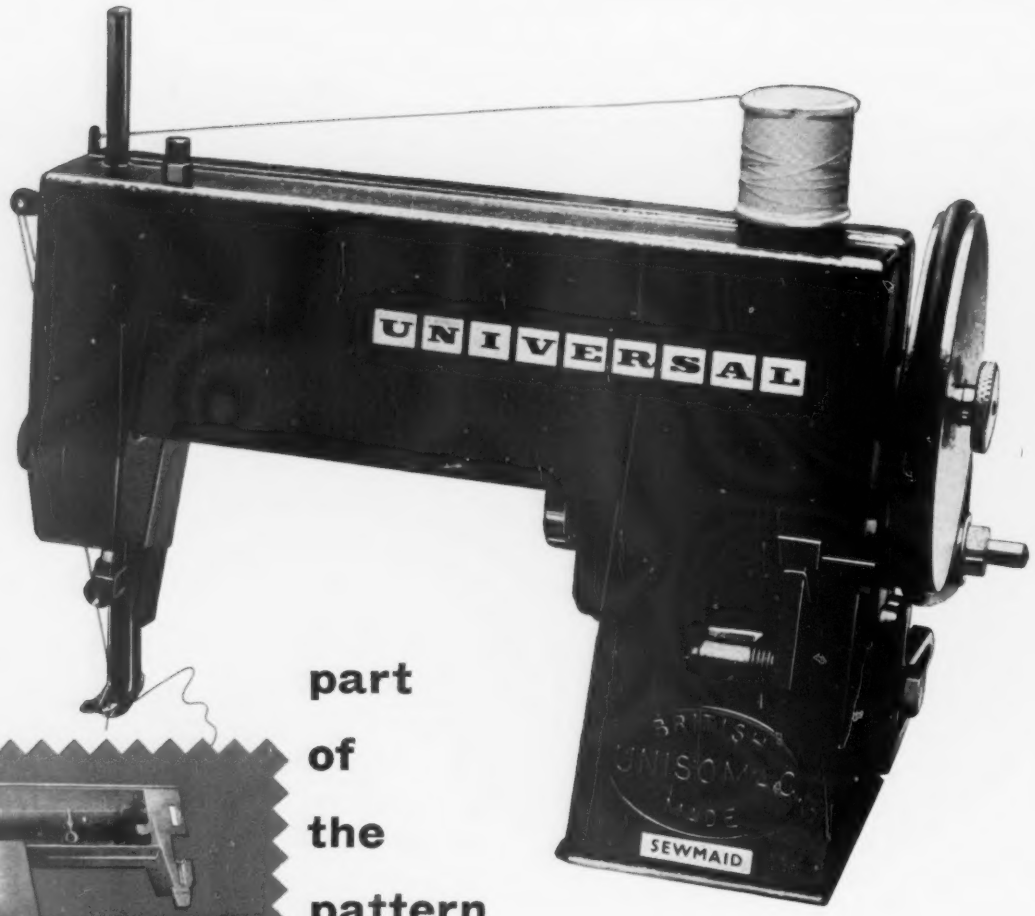

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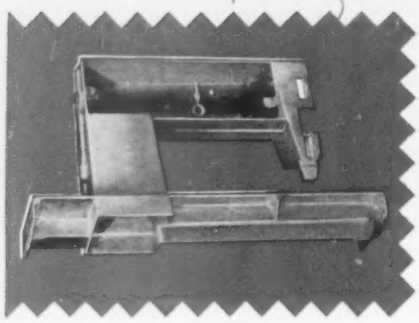

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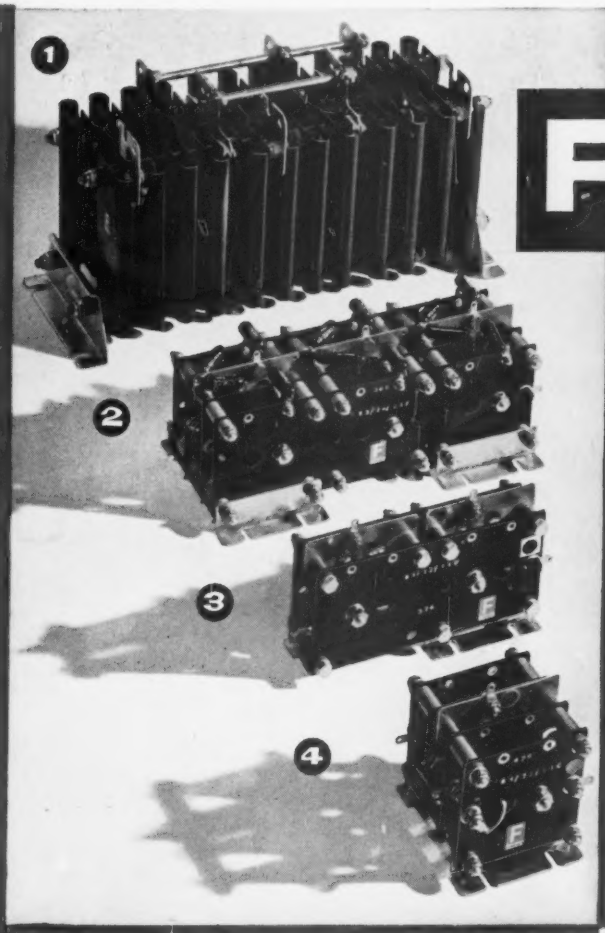

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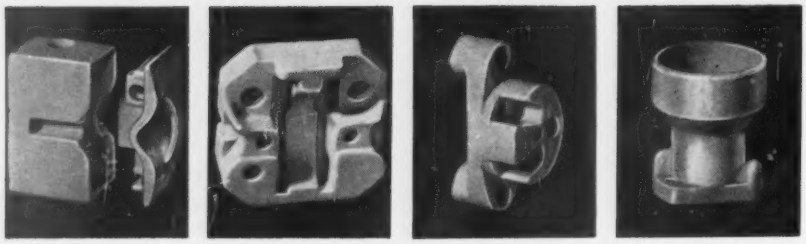

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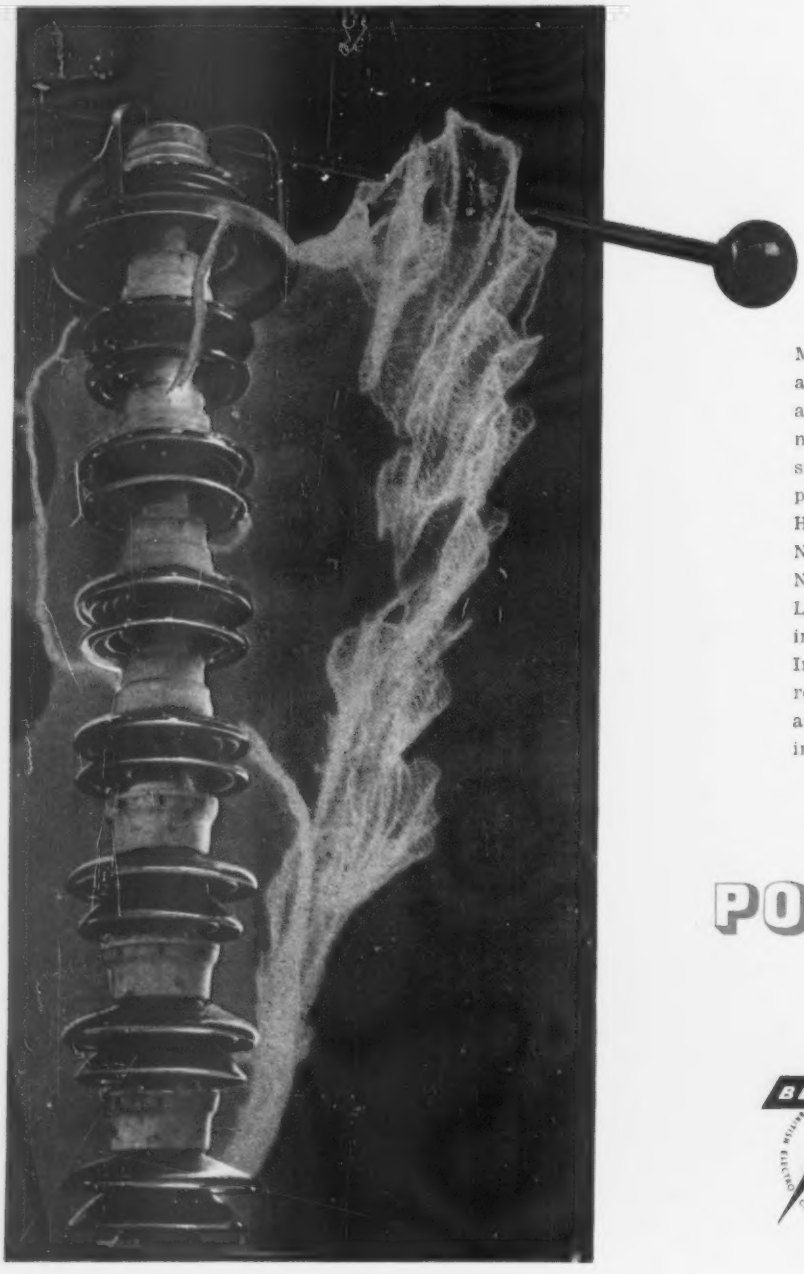

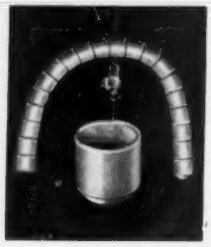

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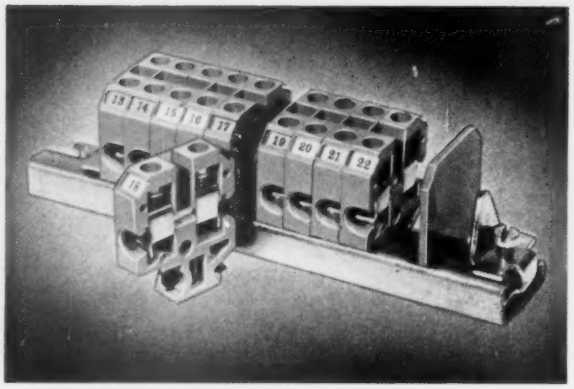

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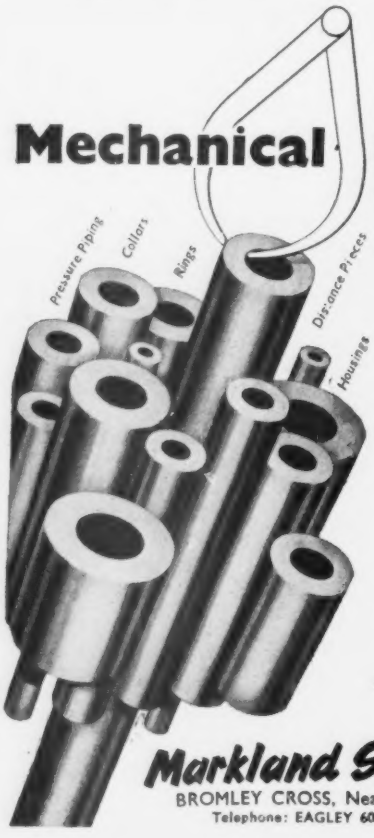

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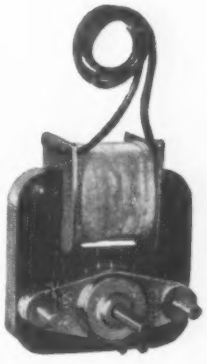

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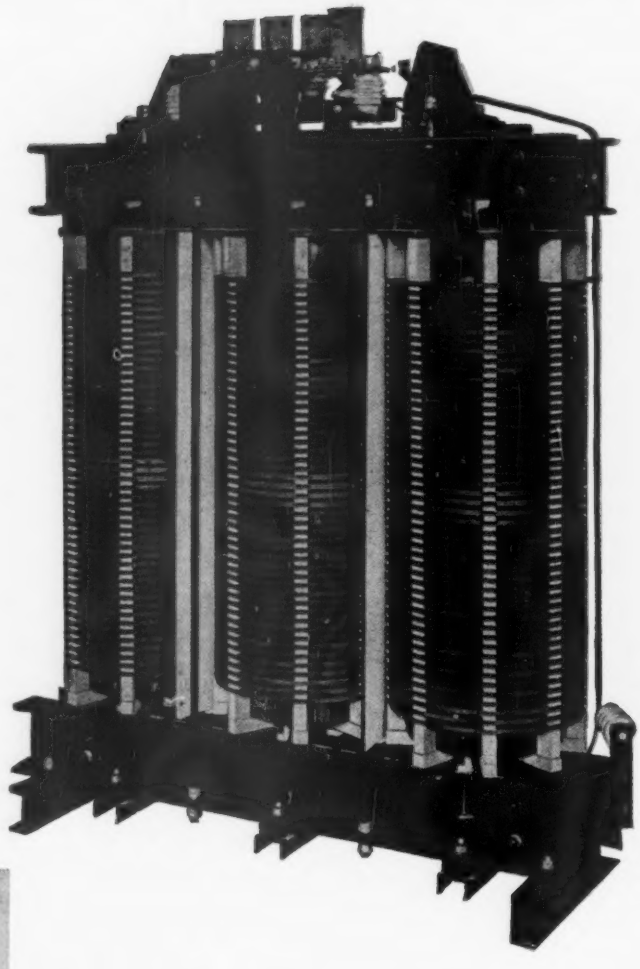

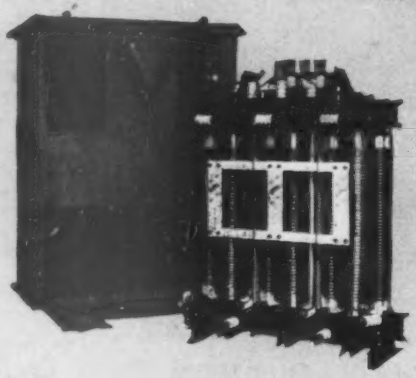

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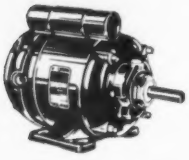

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ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Contraintes par impulsion dans les Transformateurs, 1ère Partie 3
En intercalant les enroulements dans les transformateurs on obtient une bien plus grande résistance aux impulsions. Pour des enroulements intercalés les contraintes qui se produisent dans la plupart des conditions pratiques sont données par la distribution de tension initiale. Cet article décrit la mise en programme pour une machine à calculer électronique numérique qui peut être utilisée pour calculer la distribution de la tension d'impulsion initiale dans deux enroulements d'un transformateur à deux ou à trois enroulements.

Accidents Industriels impliquant l'électricité 9
Un rapport officiel sur les accidents industriels impliquant l'électricité propose de ne pas délester automatiquement la charge électrique lorsque des défauts se produisent sur des groupes turbo-alternateurs; la charge peut agir comme frein. Dans le gros appareillage de commutation, une panne d'isolement entraîne des accidents, et les disjoncteurs devraient être mis hors service après réparation d'un défaut important afin de pouvoir changer l'huile. Ce rapport propose d'incorporer aux interrupteurs de sécurité et aux couplages associés aux machines industrielles utilisant l'électricité une commande manuelle positive.

Prévision des Prises Murales 15
L'Institution des Ingénieurs Electriciens (IEE) a recommandé à un Comité Gouvernemental l'installation de six prises murales dans les salles de séjour, de six dans les cuisines et de cinq dans les chambres à deux lits, dans les habitations.

Installations de Génération poir 1959 24
Les installation génératrices prises en charge par les organismes d'alimentation britanniques, au cours de 1959, ont totalisé 1 775 MW, en ce qui concerne les turbo-alternatures et autres ensembles, et 6 650 T/h en capacité de vapeur.

In dieser Nummer

Stromstoss-Beanspruchung bei Transformatoren, I. ... 3
Durch Verwendung versetzt angeordneter Wicklungen in Transformatoren lässt sich erhebliche Stromstoss-Beständigkeit erzielen. Bei versetzt angeordneten Wicklungen ergeben sich die Höchstbeanspruchungen für die meisten betriebsmässigen Bedingungen aus der eingeplanten Spannungsverteilung. Ein Rechenprogramm für einen elektronischen Digital-Rechenautomaten wird beschrieben, mittels dessen die Ausgangs-Stromstoss-Verteilung in zwei Wicklungen eines Transformators mit zwei oder drei Wicklungen errechnet werden kann.

Betriebsunfälle in Verbindung mit Elektrizität ... 9
Aus einem amtlichen Bericht über Betriebsunfälle, die mit Elektrizität im Zusammenhang stehen, geht hervor, dass bei Betriebsfehlern in Turbogeneratoren keine automatische Kraftabschaltung erfolgen sollte; die Stromlast kann gewissermassen als Bremse wirken. In Hochspannungs-Schaltwerken werden durch Isolationsfehler Unfälle verursacht, und Abschalter sollten nach Beheben einer ernsten Störung zwecks Oelwechsel ausser Betrieb gesetzt werden. Der Bericht schlägt ferner vor, Ueberstromschalter und Zwischengelenke bei elektrisch angetriebenen Maschinen für zwangsläufige mechanische Betätigung anzulegen.

Steckdosen-Vorschriften 15
Der britische Beruftsverband der Elektroingenieure hat einen Regierungsausschuss dahingehend beraten, dass die Zahl der Steckdosen in Wohnungen mindestens sechs in Wohnzimmern, sechs in Küchen und fünf in Doppelschalfzimmern betragen soll.

Kraftwerk-Statistik für 1959 24
Generatorenanlagen, die während Jahres 1959 von den britischen Versorgungsbehörden in Auftrage gegeben wurden, umfassten 1 775 MW in Form von Wechselstrom-Turbogeneratoren und anderen Anlangen, und 6 650 T/h in Form von Anlagen für den Dampfbetrieb.

Impulse Stresses in Transformer Windings 3
by R. A. Zambardino, DR.ING., A.M.I.E.E.

Checking Insulation on Coils 8

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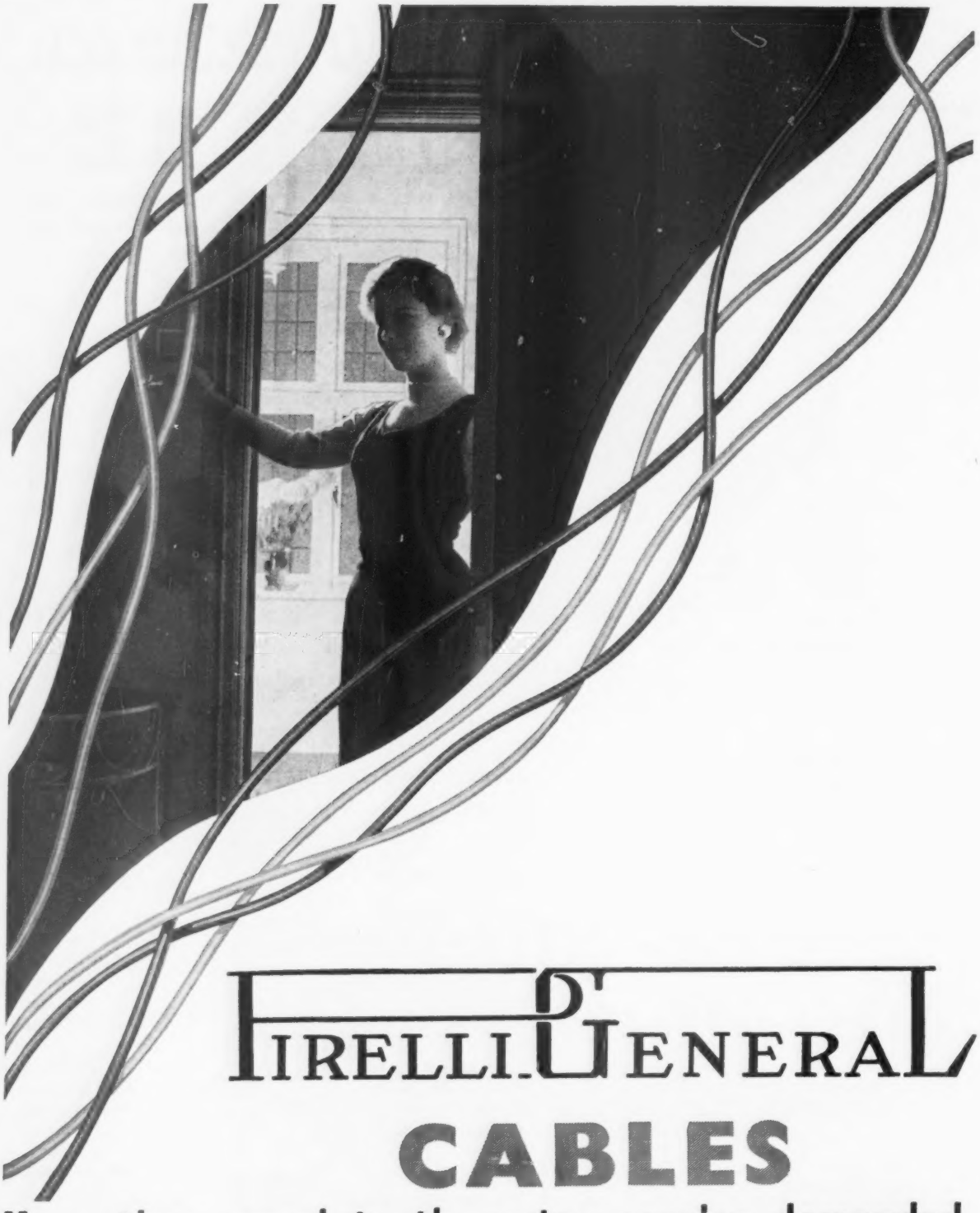

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 7 JANUARY, 1960

Editor and Managing Director:
ROY BALDWIN, M.I.E.E., Barrister-at-Law

Joint Editor:
K. C. POUNDS, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E.

News Editor:
T. W. WRIGHT

Comment

SUPPLY ENGINEERS OF THE FUTURE

Answers to many of the problems of education and training of supply engineers are offered in this week's statement by the Electrical Power Engineers' Association. These answers show ingenuity in tackling some intractable problems, and they will command respect; but for all their vigorous advancement, we take leave to doubt whether they will attract agreement in their entirety. One difficulty is that the statement is based in part on out-of-date evidence. This is particularly noticeable in the sections on graduate recruitment to the industry, which has stepped up considerably from the 1957-58 figures quoted. But it is not graduates and Dip Tech diplomees who will provide the bulk of the technical staff in the supply industry. Student apprentices, recruited at about 18 and studying through day release and evening work, will continue to be the main channel of technical recruitment. The EPEA sees Higher National Certificate as the typical qualification for these men, and belabours the IEE for making it so difficult for men studying for this examination to become chartered engineers. Does this matter so much as the Association suggests? The IEE may lose technically virile membership, but the centralised management of the supply industry can surely be fully informed on the changed situation, so that failure to obtain the AMIEE brevet, where it would have been available in earlier years, will not militate against promotion prospects. The suggestion that IEE membership regulations should be changed to suit supply educational patterns is unacceptable; that reason is wrong, whatever virtue there might be in the action itself. On the question of practical training of student apprentices, the Association makes the interesting suggestion that an additional programme should be drawn up. This "general" student training course would provide experience in both the main divisions of supply activities, with emphasis on trading and commercial relationships; but the statement is disappointingly vague on the subsequent employment foreseen for those who might take this path. Space prevents a fuller discussion here of the Association's ideas, and concentrates attention on criticism; yet the broadness of thinking they represent is something we wholly welcome.

SIX SOCKET-OUTLETS PER LIVING ROOM

Replying to a questionary issue by a Ministry of Housing committee, the IEE through its panel on adequate wiring goes on record as recommending six socket-outlets per living room and kitchen as the desirable standard of adequacy. The 1944 Post-War Building Studies No. 11 figure, which the panel cate-

Electrical groups and their subsidiaries are listed in an ELECTRICAL TIMES special section facing page 26.

gorises as an "absolute minimum standard suitable for inclusion in any byelaws that may be promulgated," was half that now advocated. There is little to quarrel with in these statements, which are made in answer to an ambiguously worded question asking for a "desirable minimum" scale of socket-outlets—when the present state of knowledge on this question is considered. What excites regret is that a professional body of engineers should have to supply such an answer without detailed analytical and statistical backing, based on inquiry and experiment. The only support offered for the level of "six" and its associated recommendations for other parts of the house lies in the length of the list of domestic electrical appliances which may be used in a room. There is no survey (apart from the rough measure of two-year-old saturation figures) of what appliances are in use, in what rooms and in what manner. The electrical industry has not been able to supply any systematic study such as that of the Building Research Station which we reported recently. Yet the present inquiry has a standing which throws into relief the danger of this shortcoming. The conclusions and recommendations will be of commanding significance; so electricity's case must be made strongly. The IEE in their evidence have done well—except for overemphasis on floor-warming at the expense of other more flexible electrical techniques—but more ammunition in favour of reasonable adequacy is needed for the time when the committee proceeds to take oral evidence in support of the written opinions it has now received.

SIMPLICITY IN EARTH TESTING

Electrical Accidents, the annual survey by the Senior Electrical Inspector of Factories, has never been lacking in outspokenness on technical topics with a safety aspect. The newly published edition, dated 1958, is no exception, and amongst comments likely to attract attention are those on earth-fault-loop impedance testing. The electrical inspectors have advocated such testing for many years, and have lent their support to the neutral-earth current injection instruments. This type has been under attack recently, as giving inaccurate results when there are substantial currents flowing in a neutral common to the tested loop and some other circuits. In the present survey, the Inspector rails against "theoretical considerations advanced" in discussing earth fault loop testing, which he considers seek "a degree of accuracy which in practice is unrealistic." His argument is two-pronged. First, that variations of impedance of some parts of the fault path with time means that no reading can, in any case, be universally true; and second, that testing by the engineer who needs to know about the earth fault loop can, by simple precautions, give results accurate enough for a situation having as its end product selection of a protective setting with something like a 400% margin of safety. The neutral-earth current injection method he considers simple and reliable, and safe in itself, with the inference that not all suggested instruments and methods offer such desiderata. At the least, this opinion will bring a welcome from those whose faith in loop testing had been shaken.

PLANT ON SCHEDULE

Commissioning figures for the CEGB during the 1959 calendar year were very close, at 1,670 MW sent-out capacity, to the official programme figure. The total is nearly half as much again as last year's total, which was kept small by adjustments made five years before to bring realism to a lagging installation schedule. In terms of set size the standard 60 MW machines continued, but the more typical pattern of the future was heralded by commissioning of the first 200 MW set, at High Marnham. During the year, now beginning, it is planned to install nearly 1,900 MW s.o. capacity, and 1961 will be larger still; but then begins a decline in nominal programmes brought about partly by Government pressure to economise on investment in new plant, partly by engineering advance which by improving availability has made it possible to look confidently to meeting a given notional winter peak with less plant nominally available. In 1960 most of the new stations or sections of stations coming into operation will have the 120 MW reheat sets, and only one 60 MW set station, so recently the standard, is in the programme amongst new sections.

COMPUTERS IN DESIGN

Electronic computers with their high speed operation have had a major effect on electrical design techniques, both in maximising performance, and in facilitating checks on particular aspects of a design other than the main consideration occasioning its selection. An example in the latter category is surveyed in an article this week, in which the response of transformer windings to impulse voltages is considered from the aspect of digital computer calculation. The particular advantages which come with computers stand out; ability to investigate economically a number of conditions for each design and each magnitude and type of impulse wave, and close correspondence between calculated results and check measurements. The latter characteristic arises because with digital computer attack, the number of simplifying assumptions made to keep the mathematics handleable may be relatively small compared with what is necessary with investigations by classical methods of analysis.

Meteor

This week's quick summary of electrical news faces advertisement page 24.

Impulse stresses in transformer windings

by R. A. Zambardino,* DR. ING., A.M.I.E.E.

IN service conditions a transformer can be subjected to impulse voltages caused by lightning. When a lightning stroke occurs in the vicinity of an overhead transmission line a surge voltage is electrostatically induced on the line and travels along it. The peak values of surges of this nature are not usually higher than 350 kV, but in some cases these peak values can be doubled at a terminal station, as a result of reflections. Higher surge voltages can be produced by lightning strokes occuring directly on the line connected to the transformer. With overhead-line end protection, the amplitude of these surges can be of the order of the impulse flashover voltage of the line insulation; in certain cases, reflections can double the peak value of the incoming surge at a terminal station. Even more dangerous would be a direct lightning stroke on the transformer itself or other station apparatus in its vicinity.

It is clearly necessary to protect transformers from these surges by avoiding any direct stroke on the station, and by limiting to a predetermined maximum the amplitude of any surge reaching the station along the overhead lines. The first requirement is met by lightning interception networks protecting the station and the adjacent lines; the second by means of surge arrestors or, more economically but less efficiently, by rod gaps. An upper limit to the amplitude of surges reaching the transformer can be fixed in this way, but this limit must correspond to a voltage much higher than the normal power frequency operating voltage, in order to avoid frequent interruptions of service caused by the slow fronted overvoltages produced by switching surges etc.

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System voltage	Power frequency test voltage kV r.m.s.	Impulse test voltage kV peak	Remarks
3·3	16	50	
6·6	22	75	
11	28	95	Standard 1
15	38	110	
22	50	150	Insulation
33	70	200	
44	95	250	level
55	115	300	
66	140	350	
88	185	450	
110	185	450	
132	230	550	Standard 2
150	275	650	
220	395	900	Insulation
275	450	1,050	
330	550	1,250	level
380	630	1,425	

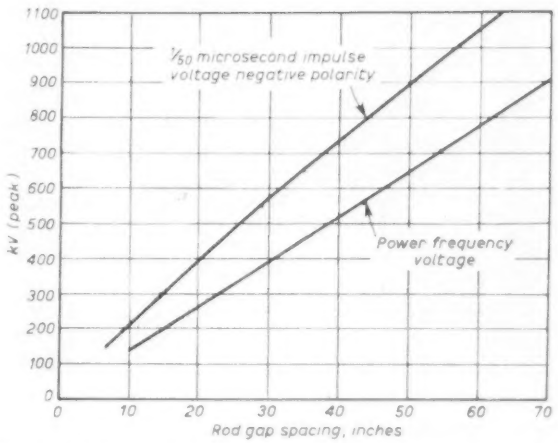

Fig. 2. Flashover voltage of rod gap for 1/50 microsecond impulse voltages and for power frequency voltages

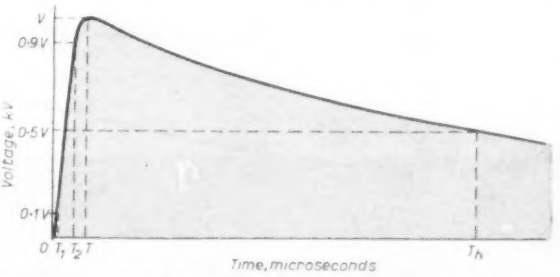

Fig. 3. 1/50 microsecond impulse voltage waveshape. Wavetail = T_h = 50 microseconds; wavetail = T; nominal wavefront, as defined by BS 923 = 1.25 (T_2—T_1) = 1 microsecond

The flashover voltage of a rod gap increases rapidly for very steep voltage waves, (Fig. 2.) Therefore, if for example on a 132 kV system interruption of service has to be avoided for power-frequency overvoltages up to 300 kV peak, it follows that the protection will limit the amplitude of atmospheric surges reaching their peak in about 1 microsecond to values of the order of five times the peak value of the normal operating voltage. In Fig. 1 are tabulated the insulation levels for power transformers recommended by the BS 171 : 1959. The stress occurring under impulse voltage conditions can consequently be much higher than for normal operating conditions, and therefore they are the main factor determining the insulation characteristics of transformers. In the last ten years, impulse tests, intended to ascertain that the transformer is able to withstand the impulse surges to which it could be sub-

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Electrical groups and their subsidiaries are listed in an ELECTRICAL TIMES special section facing page 26.

gorises as an "absolute minimum standard suitable for inclusion in any byelaws that may be promulgated," was half that now advocated. There is little to quarrel with in these statements, which are made in answer to an ambiguously worded question asking for a "desirable minimum" scale of socket-outlets—when the present state of knowledge on this question is considered. What excites regret is that a professional body of engineers should have to supply such an answer without detailed analytical and statistical backing, based on inquiry and experiment. The only support offered for the level of "six" and its associated recommendations for other parts of the house lies in the length of the list of domestic electrical appliances which may be used in a room. There is no survey (apart from the rough measure of two-year-old saturation figures) of what appliances are in use, in what rooms and in what manner. The electrical industry has not been able to supply any systematic study such as that of the Building Research Station which we reported recently. Yet the present inquiry has a standing which throws into relief the danger of this shortcoming. The conclusions and recommendations will be of commanding significance; so electricity's case must be made strongly. The IEE in their evidence have done well—except for overemphasis on floor-warming at the expense of other more flexible electrical techniques—but more ammunition in favour of reasonable adequacy is needed for the time when the committee proceeds to take oral evidence in support of the written opinions it has now received.

SIMPLICITY IN EARTH TESTING

Electrical Accidents, the annual survey by the Senior Electrical Inspector of Factories, has never been lacking in outspokenness on technical topics with a safety aspect. The newly published edition, dated 1958, is no exception, and amongst comments likely to attract attention are those on earth-fault-loop impedance testing. The electrical inspectors have advocated such testing for many years, and have lent their support to the neutral-earth current injection instruments. This type has been under attack recently, as giving inaccurate results when there are substantial currents flowing in a neutral common to the tested loop and some other circuits. In the present survey, the Inspector rails against "theoretical considerations advanced" in discussing earth fault loop testing, which he considers seek "a degree of accuracy which in practice is unrealistic." His argument is two-pronged. First, that variations of impedance of some parts of the fault path with time means that no reading can, in any case, be universally true; and second, that testing by the engineer who needs to know about the earth fault loop can, by simple precautions, give results accurate enough for a situation having as its end product selection of a protective setting with something like a 400% margin of safety. The neutral-earth current injection method he considers simple and reliable, and safe in itself, with the inference that not all suggested instruments and methods offer such desiderata. At the least, this opinion will bring a welcome from those whose faith in loop testing had been shaken.

PLANT ON SCHEDULE

Commissioning figures for the CEGB during the 1959 calendar year were very close, at 1,670 MW sent-out capacity, to the official programme figure. The total is nearly half as much again as last year's total, which was kept small by adjustments made five years before to bring realism to a lagging installation schedule. In terms of set size the standard 60 MW machines continued, but the more typical pattern of the future was heralded by commissioning of the first 200 MW set, at High Marnham. During the year, now beginning, it is planned to install nearly 1,900 MW s.o. capacity, and 1961 will be larger still; but then begins a decline in nominal programmes brought about partly by Government pressure to economise on investment in new plant, partly by engineering advance which by improving availability has made it possible to look confidently to meeting a given notional winter peak with less plant nominally available. In 1960 most of the new stations or sections of stations coming into operation will have the 120 MW reheat sets, and only one 60 MW set station, so recently the standard, is in the programme amongst new sections.

COMPUTERS IN DESIGN

Electronic computers with their high speed operation have had a major effect on electrical design techniques, both in maximising performance, and in facilitating checks on particular aspects of a design other than the main consideration occasioning its selection. An example in the latter category is surveyed in an article this week, in which the response of transformer windings to impulse voltages is considered from the aspect of digital computer calculation. The particular advantages which come with computers stand out; ability to investigate economically a number of conditions for each design and each magnitude and type of impulse wave, and close correspondence between calculated results and check measurements. The latter characteristic arises because with digital computer attack, the number of simplifying assumptions made to keep the mathematics handleable may be relatively small compared with what is necessary with investigations by classical methods of analysis.

Meteor

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220	395	900	Insulation
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330	550	1,250	level
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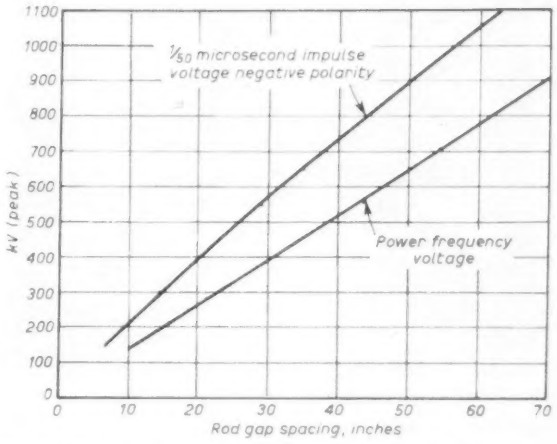

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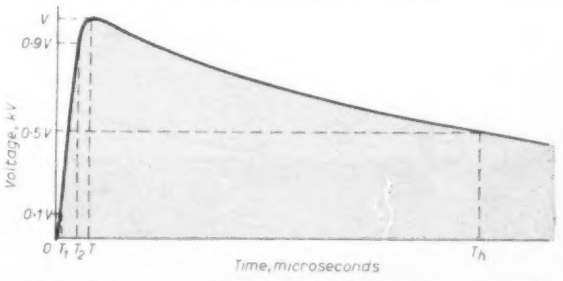

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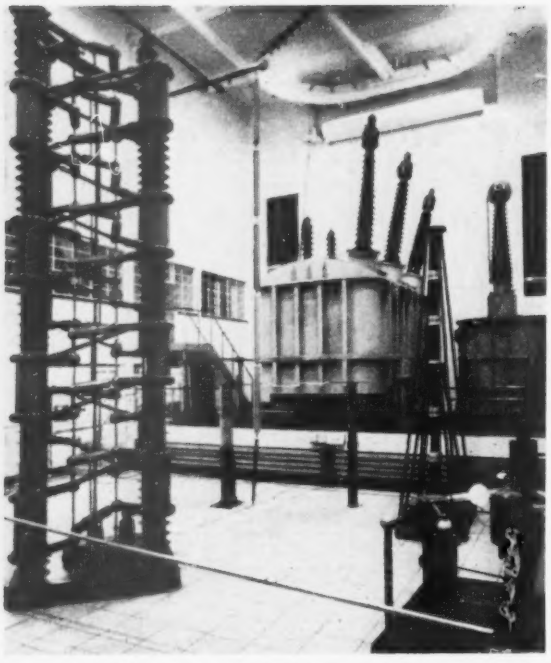


Fig. 4. View of the English Electric high voltage laboratory at Stafford while chopped wave tests are being carried out on a 230/115 kV 80 MVA large power transformer

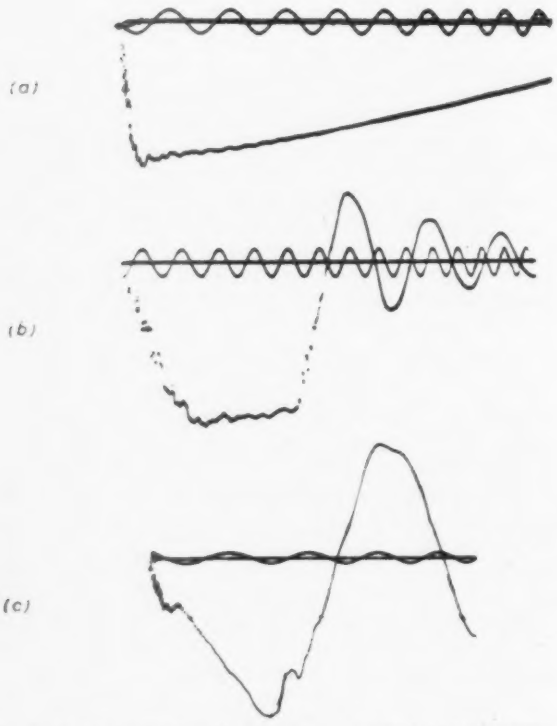


Fig. 5. Oscillograms of impulse voltage tests on a 230/√3 kV, 103 MVA single-phase transformer. (a) Full wave, 900 kV peak; timing oscillation 10 microseconds period. (b) Chopped wave, 1035 kV peak; timing oscillation 1 microsecond period. (c) Front of wave, 1240 kV peak; timing oscillation 1 microsecond period

jected in service, have become one of the most important acceptance tests for power transformers.

The impulse voltages for these tests are produced by means of high voltage generators based on the Marx circuit, and their waveshape, as specified by the British Standards, is 1/50 microseconds, i.e. the wave must reach its peak in 1 microsecond and then decay to half the peak value in 50 microseconds, as shown in Fig. 3. Impulse tests consist in the application to the transformer of full waves having a peak value equal to the insulation level of the transformer, and chopped waves having a peak value of 115% the insulation level. Some American specifications also require the application of front-of-wave tests, i.e. waves chopped on their rising front.

Fig. 4 is a photograph of the English Electric high voltage laboratory, taken while chopped wave tests on a power transformer were being carried out. Fig. 5 shows oscillograms of a full wave, a chopped wave, and a front of wave.

Full wave tests correspond to the case of lighting surges having a peak value just below the voltage at which the protection apparatus becomes effective. Chopped wave tests and front-of-wave tests are carried out by chopping the applied impulse wave by means of a rod gap set to flash over either on the rising front of the wave (front of wave) or after its peak (chopped wave). These tests correspond to the case of lightning surges being intercepted by a protection apparatus and chopped either on the front or after the peak, depending on the amplitude of the incoming surge.

The impulse behaviour of a two-winding transformer can be studied by means of the equivalent circuit show in Fig. 6.

If an impulse wave is applied to a terminal, three different stages in the ensuing phenomena within the winding can be discerned.

(a) An initial period corresponding to the steeply rising front of the applied wave. The impedance offered to this front by the inductive elements of the circuit of Fig. 6 is extremely high as compared with the capacitive elements of the same circuit. The current

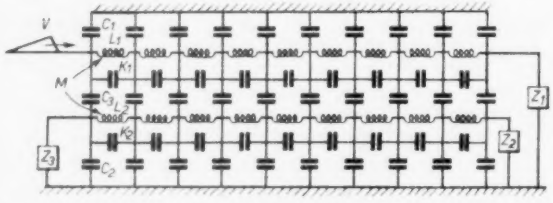


Fig. 6. Equivalent circuit of a two-winding transformer for the study of its response to impulse voltages

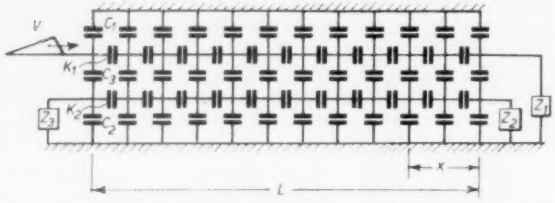


Fig. 7. Equivalent circuit of a two-winding transformer for the study of the initial impulse voltage distribution. The inductive elements included in Fig. 6, above, offer an extremely high impedance during this period, as compared with the capacitative elements

in the inductances is negligible and the voltage distribution along the two windings during this period will depend on the capacitive equivalent network of the transformer, shown in Fig. 7.

(b) A train of transient oscillations set up by the initial voltage distribution and determined by the full circuit of Fig. 6.

(c) A final steady state, corresponding to the slowly decreasing tail of the applied impulse. The voltage during this period will be mainly controlled by the inductive elements of the windings, the capacitive elements offering a much higher impedance to the incoming surge.

In Fig. 9 are shown the voltages occurring within two different types of high voltage winding under impulse conditions. The case of the applied chopped wave can be studied by considering the chopped wave as the sum of two full waves, one positive and one negative, shifted by the amount of time delay of the chopping.

Initial Voltage Distribution

The equivalent circuit for calculating the voltage distribution during the initial period is shown in Fig. 7. The voltages along the two windings, given by a fourth order differential equation, are:

$e_1 = P\exp(\alpha x) + Q\exp(-\alpha x) + R\exp(\beta x) + S\exp(-\beta x)$.

$e_2 = mP\exp(\alpha x) + mQ\exp(-\alpha x) + nR\exp(\beta x) + nS\exp(-\beta x)$.

where, α, β, m and n are functions of the capacitances, K_1, K_2, C_1, C_2, C_3 shown in Fig. 7 and P,Q,R,S, are to be determined by the terminal conditions of the two windings, i.e. earthed, floating, earthed through impedances.

The determination of the initial voltage distribution is of fundamental importance for choosing the insulation characteristics of the transformer. Considering the voltage arising in the winding to which the impulse is applied, (the other winding being short-circuited and earthed and for simplicity, at this stage, assumed to be an earthed plane) it can be shown that the maximum voltage gradient appears during the initial period at the line end. The value of this maximum gradient depends on the parameter $\alpha_0 = \sqrt{[(C_1+C_3)/K_1]}$ and Fig. 8 shows the initial voltage distribution for various values of α_0 and for grounded neutral. It can be seen that the higher is the value of α_0, the steeper is the voltage gradient along the winding, i.e. the greater are the stresses between coils. Furthermore, the amplitude of the transient oscillations marking the passage from the initial to final distribution depends upon the difference between those two voltage distributions. The more linear is the initial distribution, i.e. the small α_0, the smoother is the transition to the final distribution. Conversely high values of α_0 imply high amplitude oscillations that can raise the voltage in the winding to values much higher than the applied voltage. Fig. 10 shows the initial and final distributions and the envelope of the maximum voltages to earth within a conventional disc winding having a large α_0 and within an interleaved winding having a small value of α_0, for applied rectangular wave. Fig. 9 shows the actual voltages measured within an interleaved winding (Fig. 9, top) and a similar size conventional winding (Fig. 9, bottom), for applied 1/50 microsecond wave.

The interleaved winding, developed by the English Electric Co., consists of double-section coils whose turns are connected as in Fig. 12, i.e., adjacent turns are electrically about half a coil apart. With this type of winding high values of the series capacitance K_1 are achieved, and consequently low values of α_0. It follows that a nearly uniform initial voltage gradient is established along the winding and the amplitude of the transient oscillations is very low.

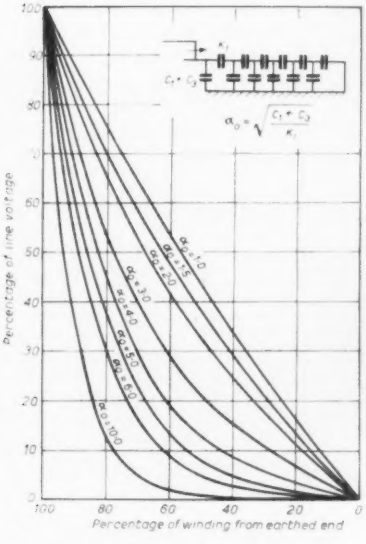


Fig. 8. Initial impulse voltage distribution in the primary winding of a transformer for earthed neutral and shorted and earthed secondary winding

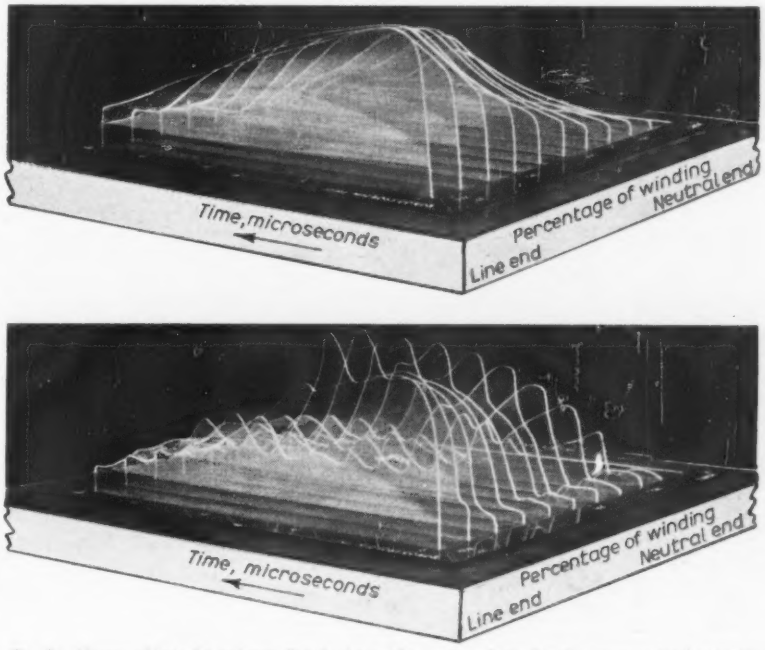


Fig. 9. Measured impulse voltage distribution within an interleaved and a conventional winding for 1/50 microseconds impulse applied to the h.v. terminal with neutral earthed. Top, interleaved winding; below, conventional winding

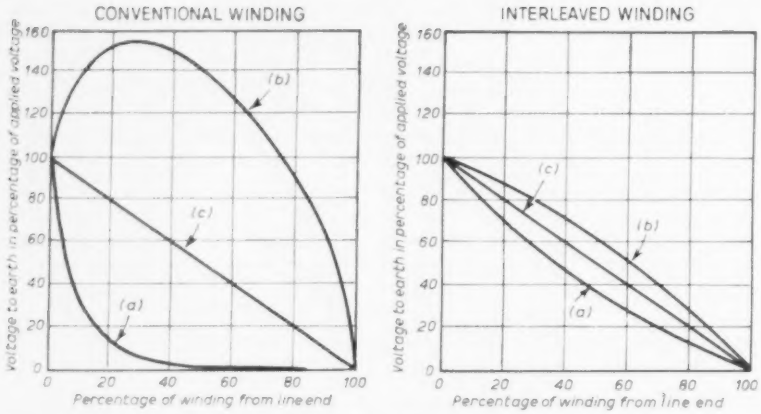


Fig. 10. Voltages in a conventional and in an interleaved winding for rectangular impulse, applied to the line end with earthed neutral. (a) Initial distribution; (b) envelope of the maximum voltages to earth; (c) final distribution

A similar influence of the series capacitance K_2 can be discerned with regard to the voltage transferred from the primary to the secondary, where the terms primary and secondary are used to indicate the winding to which the impulse is applied and the other one, irrespective of their voltage ratings. A great reduction of impulse stresses is achieved in autotransformers as a result of using interleaved h.v. and l.v. windings. In this case, if an impulse is applied to the primary, with the neutral earthed and the secondary terminal floating, the maximum voltage at the floating terminal, with conventional non-interleaved windings, is of the order of 180% of the applied voltage multiplied by the secondary-to-primary voltage rating ratio. With interleaved windings, as a result of the much more uniform initial voltage distribution, this maximum voltage is reduced to values of the order of 100% of the applied voltage multiplied by the above voltage ratio. An example of calculation for an interleaved winding autotransformer is given later and the results are shown in Fig. 14, and in Part 2.

In the more general case of impulse applied to the primary of a transformer with secondary shorted and earthed, the large value of K_2 obtained by using interleaved windings gives rise to lower voltage gradients and voltages to earth in the secondary, with consequent lowering of the amplitude of the secondary transient oscillations. In Fig. 13 is shown the initial voltage distribution in the shorted and earthed secondary winding of a transformer when this winding was conventional disc wound and when it was interleaved.

The low amplitude of the transient oscillations in interleaved windings simplifies enormously the problem of calculating the voltages arising in a transformer under impulse conditions. A complete calculation of these voltages covering all the three stages described earlier is indeed so long and laborious that the use of digital computers is in practice necessary. Moreover, even with computers, a rather long computing time is necessary for carrying out the full calculation. For instance, the computing time given for a recent computer programme calculating the impulse voltage within one winding only

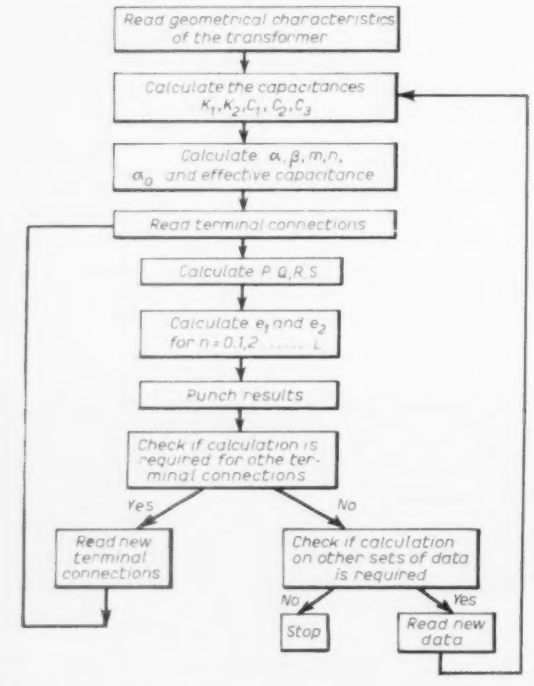

Read geometrical characteristics of the transformer
Calculate the capacitances K_1, K_2, C_1, C_2, C_3
Calculate $\alpha, \beta, m, n, \alpha_0$ and effective capacitance
Read terminal connections
Calculate P, Q, R, S
Calculate e_1 and e_2 for n = 0, 1, 2
Punch results
Check if calculation is required for othe terminal connections
Yes
No
Read new terminal connections
Check if calculation on other sets of data is required
No
Yes
Stop
Read new data

Fig. 11. Block diagram of the DEUCE programme calculating the initial impulse voltage distribution in two windings of a transformer

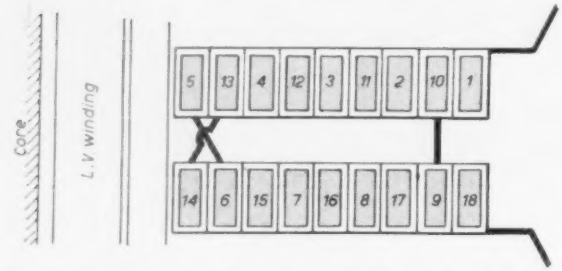


Fig. 12. Cross section through an English Electric interleaved disc coil of the type with which the present article is concerned

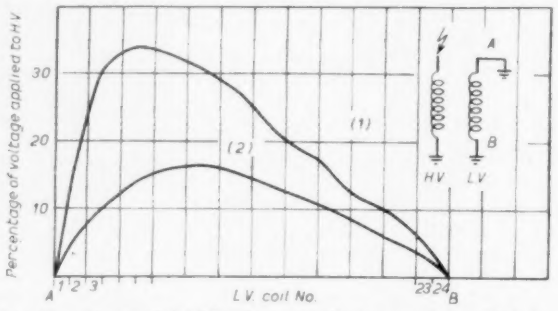


Fig. 13. Measured initial voltage distribution on the earthed l.v. winding of a transformer, for 1/50 microsecond impulse voltages applied to the h.v. terminal. Curve (1): for l.v. winding conventional disc; Curve (2): for l.v. winding interleaved

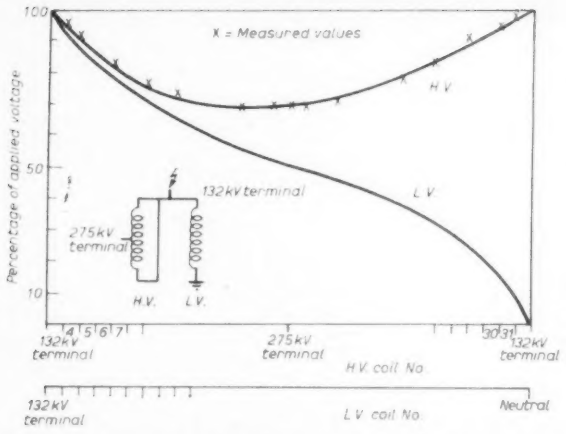


Fig. 14. Measured and calculated initial voltage distribution in the h.v. and l.v. windings of a 275/132 kV, 120 MVA autotransformer for 1/50 microsecond impulse applied to the 132 kV terminal with the 275 kV terminal open circuited

of a transformer, all the other windings being taken as earth planes, is two hours 13 mins. [Ref 19]. If the calculations were extended to cover two windings a much longer computing time would be necessary, apart from the limitations arising from the storage capacity of the computer.

As a consequence of the low amplitude of the transient oscillations occurring in interleaved windings, it follows that in the case when all the transformer terminals other than the one to which impulse is applied are earthed, all the maximum stresses for which the insulation must be designed are given by the initial voltage distribution, If some terminals are left floating or connected to external impedances, all the necessary design information can be derived by considering the initial voltage distribution and the electromagnetic voltages arising on such terminals. The latter voltages can be calculated directly by means of simplified equivalent circuits, as shown later.

DEUCE Programme

The calculation of the initial voltage distribution for both windings of a transformer does not present any major difficulties but it takes rather a long time to carry out. If various insulation characteristics are to be tried in order to select the best design, it becomes rather impractical and expensive to carry out directly the full series of calculations.

Curves or very simple calculations can be used if the only value required is the voltage appearing in the winding to which the impulse is applied, but in some cases it is important to consider the electrostatic voltages transferred to other windings. In those cases when the secondary winding is not shorted and earthed, not only is it important to determine the voltages on the secondary, but furthermore the voltages on the primary itself can be considerably influenced by the secondary. This is a condition frequently met in service. In cases when the secondary is shorted and earthed, its influence on the primary is usually very small. However, when the insulation level of the secondary winding is much lower than that of the primary, the voltage transferred to the secondary can be high compared to its insulation level.

In order to carry out the full calculation of the initial distribution speedily and economically, as a routine part of the design of transformers, a digital computer programme has been prepared. The computer used for these calculations is a DEUCE (Fig. 16.) The logical flow diagram of the programme is shown in Fig. 11. The input data are the geometrical characteristics of the windings and the terminal conditions. The results, i.e., the voltages at each coil or section of both the h.v. and l.v. winding, the values of K_1, K_2, C_1, C_2, C_3, z_0 and of the effective capacitance of the transformer as seen from the terminal to which the impulse is applied, are calculated and punched on cards in about 40 seconds.

The terminals of each winding of the transformer can be considered earthed or floating or earthed through capa-

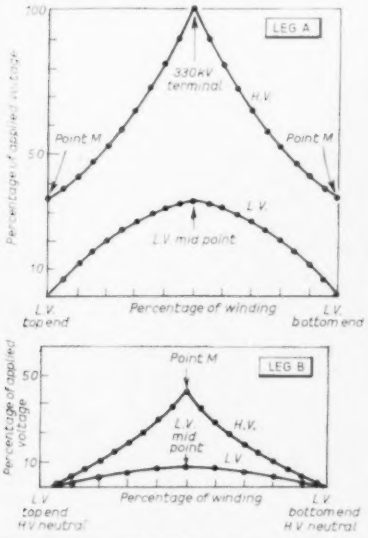


Fig. 15. Calculated initial voltage distribution in the h.v. and l.v. windings of a 330/138·6 kV 54 MVA 2 limb transformer. (See Fig. 17 for circuit and method of calculation)

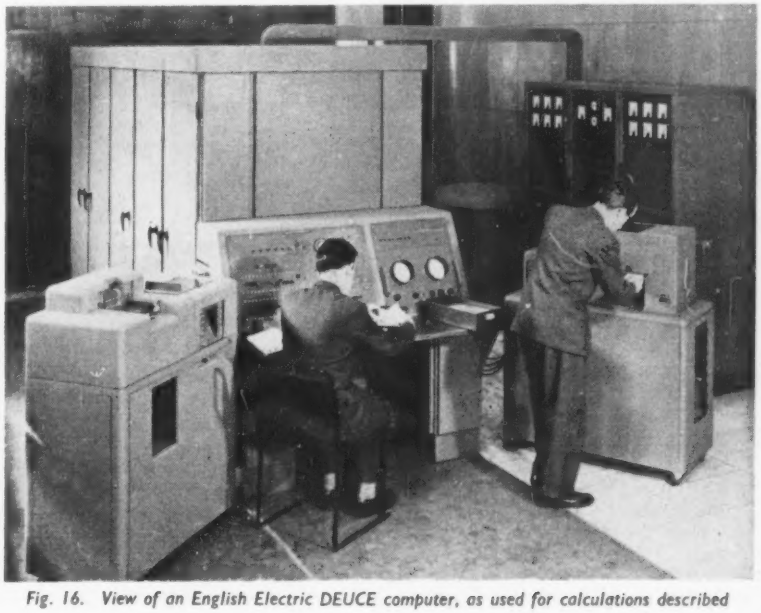
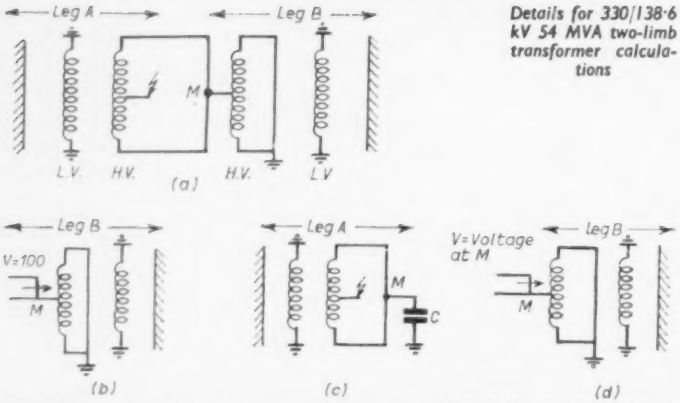


Fig. 16. View of an English Electric DEUCE computer, as used for calculations described



Details for 330/138·6 kV 54 MVA two-limb transformer calculations

Fig. 17. Circuit and method of calculation for a 330/138·6 kV 54 MVA two-limb transformer. (a) representative diagram of the transformer. (b) first calculation to evaluate the effective capacitance C of leg B as seen from Point M. (c) Second calculation to evaluate the actual voltage distribution on leg A. Value of C taken from first calculation. (d) Third calculation to evaluate the actual voltage distribution on leg B. Amplitude of the applied voltage taken from second calculation

citances (cables, bushings, tapping windings etc). If the transformer has three windings, in calculating the voltage in the primary and secondary the programme will also take account of the influence on these voltages of a third winding and often give the voltage on that winding.

In most cases it is possible to take into account the effect of non-homogeneous parts in the windings by a step-by-step process. (See Fig. 17.)

Fig. 14 shows the initial voltage distribution in the h.v. and l.v. windings calculated for a 275/132 kV, 120 MVA autotransformer, for impulse applied to the 132 kV terminal and the 275 kV terminal left floating. The voltage distribution along the h.v. winding was measured on the actual transformer and the values, plotted in the same figure, show a perfect agreement with the calculation. A direct calculation of the voltage distribution for this case would have implied particularly long calculation, as it is necessary to take both windings into account. The DEUCE calculation was carried out in two stages: for impulse applied to the two ends of the h.v. coil stack and l.v. shorted and earth, and then for impulse applied to the l.v. terminal and the two ends of the h.v. coil stack and the l.v. neutral earthed. The two sets of results, summed together, corresponded to the case under consideration, due to the principle of superposition. The total computing time was 1 minute and 20 seconds.

Fig. 15 shows the initial voltage distribution in the h.v. and l.v. windings of a 330/138·6 kV, 54 MVA two limb transformer. Measurements of the voltage distribution along the h.v. winding taken afterwards on the actual transformer were in complete agreement with the calculations. This case would have necessitated long direct calculations due to the different characteristics of the windings on each limb.

The DEUCE calculation was carried out in three stages, considering each limb separately as shown in Fig. 17. The first calculation, for limb B, was carried out for a voltage of amplitude 100 applied to point M and therefore gave, together with the corresponding voltage distribution on this limb, the value of the effective capacitance of limb B as seen from point M. For the second calculation, on limb A, point M was considered earthed through the above value of capacitance that was fed as a data; the calculations gave therefore the actual voltage distribution on limb A. For the third calculation, on limb B, the voltage at M calculated on the second stage was fed as a data and taken as the amplitude of the voltage applied to M; the calculation gave therefore the actual voltage distribution on limb B. The total computing time for these calculations was under two minutes.

The programme is completely automatic and can be incorporated in a general programme for carrying out the full design of transformers. *(To be concluded)*

CHECKING INSULATION ON COILS

POWER factor measurement at two voltages as a measure of insulation condition is suggested by three US engineers, Messrs D. A. Finlay, R. G. Brearley, and C. C. Louttit, in a paper summarised in the current AIEE journal *Electrical Engineering*. These engineers tested some 360 coils removed from the stator of a 35 MVA, 13·2 kV waterwheel generator, initially testing them for power factor at 8 kV and at 12 kV. They noted the numerical difference between these two results (the "tip-up"), and used this as a measure of extent of internal voids in a coil.

To correlate the results with condition of internal insulation in the coils, 62 coils were dissected, and graded into four groups from "acceptable" to "terrible." It was found that the position of the coils electrically in the winding (i.e., the voltage to earth at which they operated) was significant. The worse two groups of coils ("bad" and "terrible") were limited to those having tip-ups of over 3% and formerly located in electrical positions at which operating voltage was over 4 kV to earth. On a basis of this work, the authors divided the tested coils into four groups according to the tip-up recorded, scrapping those which had high tip-up and had operated at relatively high voltage to earth, and using for line-end positions only coils which had low tip-ups.

Correlation of this work with coils removed from duplicate windings suggested that the technique could be applied to all coils built to the relevant specification, regardless of age. Further tests would be needed to determine whether the method can be extended to coils of different insulation systems.

The authors say that d.c. breakdown prediction and dielectric discharge tests failed to indicate that over 10% of the coils in the generator had internal insulation which was in a severely deteriorated state. Further, ionisation probe testing failed to locate better than 10% of the "bad" and "terrible" coils.

They conclude that since no deterioration of the internal insulation was found in the neutral half of the winding, it was corona attack, not heat or vibration, that was the essential factor causing destruction of insulation at the line-end of the coils.

They argue that the method of power factor testing which they applied, besides being non-destructive, provides a qualitative picture of the coils as a group. It was preferable to high potential turn-to-turn and earth tests.

Accidents and their prevention

FACTORY INSPECTORATE'S ELECTRICAL REPORT FOR 1958

THE report of HM Inspectorate of Factories on electrical accidents and their causes assumes each year greater importance as a guide to safe practice, as well as continuing the factual work of detailing and analysing such accidents and showing how they occur. The latest report, covering 1958 and published last week, has a detailed study of limit switches and interlocks in its section "Safety"; it also deals at some length with recent developments in electricity supply, notably on turbo-alternator protection, switchgear maintenance, substation enclosures and telecommunication applied to system operation. The emphasis this year on electricity supply is also maintained by setting out fire-fighting and fire-protection practices in electrical stations.

Dealing first with statistics, the report notes with regret that the 1958 total of 714 accidents is above the 1957 total (687). There were also 124 dangerous occurrences during the year not associated with accidents. The accident total includes 38 fatalities, six more than in 1957 and 127 cases of welders' eye-flash. In addition to these fatalities, a further 125 fatal accidents came unofficially to the notice of the Inspectorate, bringing the total known electrical fatalities during the year to 163.

Nature of Injuries

The number of accidents involving shock, with or without burns, amounted to 316; those involving burns, with or without shock, were 424, whilst the number involving both burns and shock amounted to 161. Out of the 316 persons who received shock, 53 became unconscious; the importance of artificial respiration is demonstrated by the fact that 23 of the 49 persons who received this treatment recovered. The four who did not died. Eight died from other injuries, such as burns or falls.

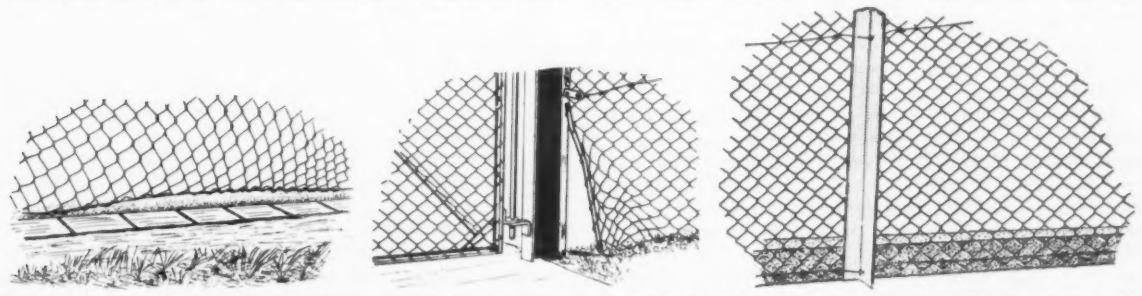
Distribution of accidents according to apparatus is given in the accompanying table, which demonstrates that portable hand tools, overhead crane or trolley wires and contact by cranes or similar machines with o.h. distribution or transmission lines still form the major causes of fatal accidents. Out of the 38 fatalities, 13 were skilled men (three supervisory staff, six electrical craftesmen and four fitters or erectors) and the remainder unskilled, of which the largest number came from other than electrical trades. An analysis of 75 shock accidents (10 fatal) involving portable apparatus shows that 25 were due to faults in the apparatus itself, 18 to faults in cables and flexibles, 28 to faults in plugs, adaptors and couplings, and four to faults in sockets and wiring.

In reviewing developments in electricity supply, the report makes passing note of the development of very large units (such as the 550 MW set at Thorpe Marsh), in relation to the correct functioning and integrity of supply to the auxiliaries. Because of their size, motors driving auxiliaries are increasingly supplied at 3·3 kV or 6·6 kV and the Inspectorate voice their disquiet at finding what appears to be an abnormal number of explosive failures of the cable boxes on these motors. Since machines at these voltages have been in common use in industry for many years, and there is no evidence of change in practice, these failures are surprising. One reason suggested in the report is that of bad jointing techniques if the work had been carried out by installation staff not widely experienced in h.v. work, rather than by high voltage mains jointers.

Turbo-alternator Failures

The report draws comparison between the turbo-alternator failures at Uskmouth and at Calder Hall B generating stations. In both cases, the electrical load was shed from the machine and the overspeed governor gear failed to operate. The report concludes that although in the past it has been considered good practice to rely on the governor gear to prevent loss of speed control on the machine, it is undesirable to dispense with the stabilising and braking effect of the electrical interconnection and load if this can possibly be avoided.

In dealing with distribution switchgear, the report comments that the position in replacing gear of inadequate capacity has tended to become less satisfactory. Moreover, concern has also been felt over the failure of several more modern 11 kV circuit-breakers to clear single-phase faults which should have been within their capacity.



Two obvious cases of poor substation enclosure resulting from incorrect erection of chain-link fencing and straining wires. The gap shown on the left is caused by slack in the straining wire; that in the centre stems from failure of a wire termination due to rusting. A concrete curb cast on site and installed (as shown right) round the perimeter of the substation will give best protection at foot of fence. Care is also required to ensure that the gap below the gateway is kept to a minimum

Although of different designs and make, they were all of the plain-break type with assigned breaking capacities of the order of 100 MVA.

Apart from failure to interrupt the arc, the most usual cause of danger in switchgear is insulation breakdown, which may occur some time after clearing a heavy fault or after a series of faults which may arise during a thunderstorm. The oil becomes contaminated with carbon which eventually settles out on the insulating surfaces until ultimately the switch fails, although this may be several hours later. After heavy faults, circuit-breakers should be taken out of service and cleaned as soon as possible; usually the oil requires changing. This practice would also eliminate danger from the possibility that the oil may have dissolved large quantities of flammable gas which could be ignited by corona discharge.

Switch Design

Defective or unsuitable design of isolating switches is also regarded as a common cause of failure, trouble usually occurring when, as a result of a mistake, or failure of an interlock, a live conductor is inadvertently earthed, or an earthed cable is switched on to a live circuit. As well as pointing out the vital necessity of proving by test that any such switch should be capable of closing on to the maximum short-circuit which can occur at the point where it is installed, the report also adds a reminder that such switches should never be

Analysis by apparatus of reportable electrical accidents in 1958

Apparatus	Fatal		Total	
	Men	Women	Men	Women
Portable and transportable:				
Hand tools	10	—	69	3
Heaters and irons	—	—	1	1
Lamps	1	—	15	—
Testing sets, including lamps, instruments	—	—	20	3
Plugs, sockets, couplings, adaptors	2	—	24	3
Cables and flexibles	1	—	19	2
Hand welding, shock and burn	—	—	24	—
Fixed:				
Rotating machines	—	—	6	—
Transformers, reactors	—	—	5	—
Switchgear above 650 V	3	—	47	—
Switchgear below 650 V	—	—	130	3
Fusegear	2	—	29	—
Crane, trolley, wires, etc.	8	—	26	—
Lamps	—	—	17	1
Cables and accessories	2	—	77	3
Test leads, terminals	—	—	12	2
Overhead lines:				
(a) Contact by cranes, etc.	8	—	14	—
(b) Contact by persons, materials, tools	1	—	4	—
Not classified	—	—	23	4
	38	—	562	25
Electric welders' eye-flash	—	—	127	—
Totals	38	—	689	25

closed a second time on to a fault without having been taken out of service, the contacts cleaned or changed and, if necessary, the oil changed. It cites a case of a 150 MVA fault-making switch being closed a second time on to a fault, and disrupting, even though the second fault was no more than 20 MVA.

In reviewing the operation of limit switches and interlocks from the safety aspect, the report starts from the fundamental premiss that the first requirement of a limit switch is that it shall not fail to operate. To this end, it considers positive mechanical operation of the switch essential. In other words, the switch must always be forced into its safe position and should not rely solely on such media as gravity, or spring action, for operation, in view of the likelihood that such operation may be defeated either deliberately or inadvertently as the result of failure of the spring or sticking of the operating mechanism.

Where possible, however, the report recommends the use of a positive mechanical interlock between a guard and the main switch and isolator in preference to a limit switch. Interlocks of the desired type can be constructed quite simply, involving in many cases nothing more than two bars, two discs, or a bar and a disc which are so slotted that whilst one is moved the other must remain fixed. It is also possible to arrange for the guard to carry a projection which interlocks with the handle of an industrial ironclad switch.

On control circuits associated with limit switches and interlocks, the report again emphasises the importance of ensuring failure to safety. In many cases, for example, it may be possible for an earth fault on the circuit to by-pass the safety switches and render the circuit dangerous. Any possibility of such sneak circuits occurring is, of course, to be avoided and the report reiterates the principle of design that, in a circuit energised between line and neutral, all switches should be on the line side of any contactor or other coil they may control. Alternatively, the limit switch may be arranged so that, on opening, it also short-circuits the operating coil.

Loop Impedance Testing

The report returns to the subject of earth fault loop impedance testing, confirming the Inspectorate's preference for the neutral-loop test as against the phase-loop test. The main concern of the Inspectorate in raising the subject again is the accuracy of the results obtained. They regard as unrealistic the degree of accuracy which has been suggested as being desirable in practice. Variations in earth electrode resistances, and the possibility of fortuitous earth paths, make exact reading to a few per cent of no practical value. It is, they argue, far better to instruct maintenance staffs in the significance of such facts rather than encourage them to work to a value which may be exact only at the time of making the test and which, moreover, relates to a circuit where a safety factor of 400% is an acknowledged desideratum.

They suggest that one of the major difficulties in this matter, errors due to voltage drop in the neutral conductor, can often be avoided by making the test when the voltage drop can be expected to be a minimum, as at lunch time. By means such as this, or, more effectively, by making a "low-high-low" run of test currents, the plant engineer can gain knowledge of his earthing system which would give him information about conditions quite impossible to obtain by a single loop-test reading.

The section on safety includes a warning on the use of small portable fluorescent hand lamps, pointing out certain objections to the original design, and reminding users that lamps of this type have not been produced in designs suitable for certification as flameproof equipment. It also gives a restatement of the Inspectorate's objections to earthed concentric wiring, particularly for supplying portable tools. Their primary concern is that reliance on the sheath of m.i.c.s. cable as a return conductor is undesirable for fear of fracture opening the circuit and rendering the case of any equipment on the remote side of the fracture alive.

In its section on fire risks, the report makes a comprehensive survey of current fire-fighting and fire protection practice in electrical stations, confirming that techniques in use have reached a satisfactory degree of reliability. It also deals briefly with floor-warming and block storage heaters, stressing the need for an over-riding maximum surface temperature control for the latter. Such control should take account of thermal delay, which results in surface temperature continuing to rise for a time after the supply has been disconnected.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Gas Turbines and Diesels

THE letter from Mr R. G. Fuller, which was printed in your issue of 10 December, tempts me to suggest that he would be interested in the full text of the presidential address given to the Institution of Mechanical Engineers on 14 October. The summary which was printed in your issue of 22 October, though excellent in many ways, was only about one tenth the length of the full address, and in such circumstances it is inevitable that some of the arguments are omitted and therefore some of the emphasis lost.

When considering the higher maximum cycle temperature of the free piston engine, Mr Carter's point concerned the fact that the thermal efficiency of any heat engine is enhanced when the difference between the maximum and minimum temperatures of the thermodynamic cycle is increased. In any wholly rotary gas turbine, the maximum temperature of the cycle corresponds to the inlet temperature to one of the turbines and in consequence is limited to a value that the turbine materials can withstand; whereas the maximum temperature of the thermodynamic cycle of the free piston gas generator occurs in the diesel cylinders, and can, therefore, be permitted to reach much higher values, with consequent improvement in fuel consumption and certainly without distress to the turbine.

Mr Fuller is quite right to point out that in the largest sizes, the turbine of the free piston engine can be directly coupled to an electrical generator, although I am sure he will readily admit that in the great majority of cases gear boxes with large speed-reduction ratios are used. It is perhaps unfortunate that in your summary the phrase concerning direct coupling was taken from a context in the presidential address, where marine propulsion was receiving more attention than land based power generating stations.

S. H. Henshall, B.SC., A.M.I.MECH.E., M.I.MAR.E.,
CHIEF DEVELOPMENT ENGINEER,
CROSSLEY BROS. LTD.,
MANCHESTER, 11.

Brochure for Retailers

I SEE Mr L. C. Penwill has taken me to task (17 December) for my criticism of the brochure, although he seems even more annoyed at my using the letters ECA instead of the Retail Section of the National Electrical Contractors' Trading Association.

I apologise for this *lapsus calami*, and I most wholeheartedly agree with him that any trader should be a member of the association which caters for his particular trade. I would even go further and say he should be an active member and not accept the benefit without some contributory efforts on his own part—although this does not seem any more general in the NECTA membership than in many other associations and unions.

I suppose there must be over 6,000 retailers in the country: I wonder how many have made use of this sales effort? In my own district, inquiries among a good number of retailers produced only two brochures but handfuls of leaflets of all sizes, shapes and colours.

I am pleased that the association (through Mr. Penwill) welcomes constructive criticism, and I hope the members will be less lethargic and more forthcoming than usual and give it to him; for I am sure NECTA does not claim to be the *ne plus ultra* of the advertising world, and criticism is the only way by which we can learn from the opinions of others. Of course many manufacturers have expressed approval of the present effort: it has cost them so little to get their names within the cosy circle of the retailers' clientele. Of course some retailers have approved: it is their own brochure with their name emblazoned (even if they have to rubber stamp the order forms) on the front, at a small cost in time and effort to themselves.

But I still hope to see a really good class, colourful and attractive sales brochure produced by NECTA, worthy of that association and a real challenge to the colourful publicity of the large stores and electricity boards.

"Peregrin."

Cooker Circuit Loading

I WAS interested to note in your issue of the 31 December some comments by *Megohn* on cooker circuit loading.

My own Association has been perturbed about the growing loading of domestic cookers for some considerable time. It feels that now that 10 to 12 kW cookers are quite common, the ordinary 30 amp cooker circuit and control unit are no longer adequate. The electrical contractor can, of course, if he knows that a heavy cooker is to be installed, install an adequate wiring system, but the only cooker control units to a British Standard are rated at 30 amp. An approach was indeed made to the BSI suggesting that a British Standard should be prepared for a cooker control unit of 60 amp rating. However, a reply was ultimately received to the effect that there was insufficient demand for a cooker control unit of this rating, and it was not considered prudent to embark on such a standard at the present time.

Oddly enough, several manufacturers do not seem to hold this view, for last year several units were introduced by various manufacturers of a rating in excess of 30 amps.

I am, of course, aware of the tests taken with recording ammeters by electricity boards during a Christmas season when it is held that this cooker is likely to be most fully used. Notwithstanding these tests, my Association would like to see a much more prolonged investigation before it would agree that the potential and actual loading of a cooker circuit are such that a 30 amp rating is all that is necessary.

L. C. Penwill, C.B.E., COMPANION I.E.E.
DIRECTOR, ELECTRICAL CONTRACTORS' ASSOCIATION,
LONDON W.C.I.

Housing Inquiry. The inquiry by the Ministry of Housing mentioned in our *Comment* this week has been instituted by a sub-committee of the Central Housing Advisory Committee. The sub-committee is required to consider the standards and design of equipment applicable to family dwellings and other forms of residential accommodation whether provided by public authorities or built by private enterprise.

Training engineers for supply

E.P.E.A. CRITICISES I.E.E. MEMBERSHIP REQUIREMENTS

IDEAS of a sub-committee of the Electrical Power Engineers' Association on education and training for technical staff in electricity supply are set out in a statement issued by the Association. The statement has some hard things to say about trends in IEE membership requirements, and makes important suggestions for introduction of a new type of student apprentice training.

After summarising the duty placed on supply authorities to provide facilities for education and training, the statement goes on to examine the position at the time it was prepared. (This appears to have been before publication of the 1958-59 annual reports of the Electricity Council and the Boards, and before the recent Survey of Scientific Manpower.) Graduate trainees who undergo a two-year course with the supply industry fell from 143 in 1953-54, to 101, 64, 49 and 42 in succeeding years. Of these, the great majority were Higher National Diploma holders; the number of university degree men were only 25, 8, 7, 9 and 5, respectively.

Student apprentices come for a five-year training period, entering the industry with GCE or ONC. They continue study while training. Student apprentice recruitment was 1,500 in 1954-55, and in succeeding years 1,200, 1,846 and 2,124. The statement calls this growth "healthy."

If the professional origins of new members of the EPEA be taken as an indication of sources of recruitment to the supply industry, it is found that only 26% come from supply industry training schemes, 35% are promoted from manual grades within the industry, and no less than 39% recruited from outside the industry.

With this background of statistics, the statement expresses the sub-committee's doubts whether the industry is going the right way about making provision for its future leaders; not only board chairmen and the like, but senior engineers generally. Specialisation is seen as a bogy, and the claim is advanced that the industry needs some engineers of good general technical knowledge with leadership and managerial qualities predominating.

Student Apprentices

The pillar on which supply industry staff training must rest is the student apprenticeship, in the opinion of the sub-committee. With his long practical training within the industry, the student apprentice is able to make contact with all aspects of supply. Careful initial selection of such apprentices is required and, from the beginning, no sharp line should be drawn between engineering and management functions. The characteristics which make a successful power supply engineer are listed as: all-round general intelligence, technical aptitude and intuition, an interest in people, and a natural grasp of basic commercial principles.

In the early years, students should be watched, and those who wish to specialise, and have the ability, given the opportunity of obtaining a university degree. The great majority, however, should proceed to Dip. Tech. or HNC; and the sub-committee thinks that HNC is the qualification that will remain within reach of most student apprentices.

This consideration leads into the report's attack on the IEE. The sub-committee think it unfortunate "that the IEE should have so tightened its requirements that the way to corporate membership via the HNC route is, while not entirely blocked, now very narrow." The statement points to the number of eminent engineers who have come to chartered status via HNC, and continues "yet the IEE would now reject these men presumably as unfit to be regarded as professional engineers, a piece of nonsense that requires no emphasis on our part." The sub-committee suggests that the Electricity Council should ask the IEE to look again at its new entry requirements with a view to making these less exacting, until such time as the present shortage of professional engineers is gone.

Future Policy

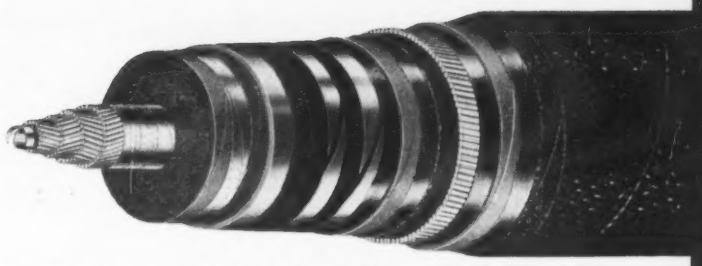
Turning to the future as regards the supply industry itself, three types of student training course are advocated. The first two are entitled generation specialisation and distribution specialisation, which would largely correspond to schemes already in existence. A third type of training is new. It is called, depressingly, "general, without specialisation," and would be intended for those who preferred to be trained broadly in the electricity supply business with special emphasis on trading and commercial relationships. The sub-committee feel that on completion of training, such "all round" engineers would find a ready niche in the employment of the CEGB as well as that of the area boards. There might be some administrative difficulty about organising such apprenticeships, but this could be overcome if they were handled by the Electricity Council.

So far as graduate training is concerned, the scheme for university scholarships to be offered by the CEGB and area boards is thought to promise well. It is based on recruitment by intensive approach to schools.

The sub-committee record their belief that there is a need for an expansion of training for established adult engineers. They do not like the idea of "appraisal" systems for personal development, in which individuals are assessed for their strengths and weaknesses to help those responsible make decisions on what future training is needed. They fear that any record of such characteristics will be used to influence promotion. They suggest more correspondence courses, part-time day release as a matter of right to all junior technical staff, and more industry-organised training, plus temporary staff exchange arrangements between sections of the industry.

In conclusion, the sub-committee call for a higher automatic salary progression for entrants to the supply industry. They feel this would have a marked effect on improving the quality of those recruited.

330 kV cables for Kariba



THE Kariba hydro-electric scheme has called for an unusual cable installation to convey power, generated by the six turbines located in a cavern hewn in the side of the gorge, to the 330 kV switchyard. Even though a specially compact design was evolved for the switchyard, it was too large to locate either on the dam or above the power station and it has been necessary to level two small hills adjacent to the station to form a suitable site.

Cable Scheme

The cable installation is notable both for its power-carrying capacity and for the length of horizontal and vertical runs between the underground transformer hall and the switchyard terminations. Three groups of three cables are used, with one spare cable per group. Each cable has a current capacity of 500 A, giving a total power transfer for a three-phase group of 285 MVA. The longest length of individual cable is 650 yards, sufficient to link terminations in the underground transformer hall to the switchyard without intermediate joints.

From the transformer hall the cables pass through an 80 yard long horizontal tunnel in sand-filled troughs. At the end of this tunnel they are carried through a vertical shaft for a further 180 yards, and complete the run to their terminations over steeply rising ground. In the vertical shaft the cleats are arranged to support the cable with a wave formation to avoid possible temperature stresses. The cable run above ground to the switchyard is completed in concrete chases.

Special techniques were evolved for lowering the cables into the vertical shafts. The cables were paid out down the shaft by a specially designed 10 ton winch at a controlled rate by a wire rope attached at 20 ft intervals by temporary wooden cleats. These cleats were removed at the shaft bottom, and the cable was then drawn through the ducts to the transformer hall by a separate winch.

Cable Construction

The Kariba cables were manufactured at the Erith works of British Insulated Callender's Cables Ltd. and have several unusual features.

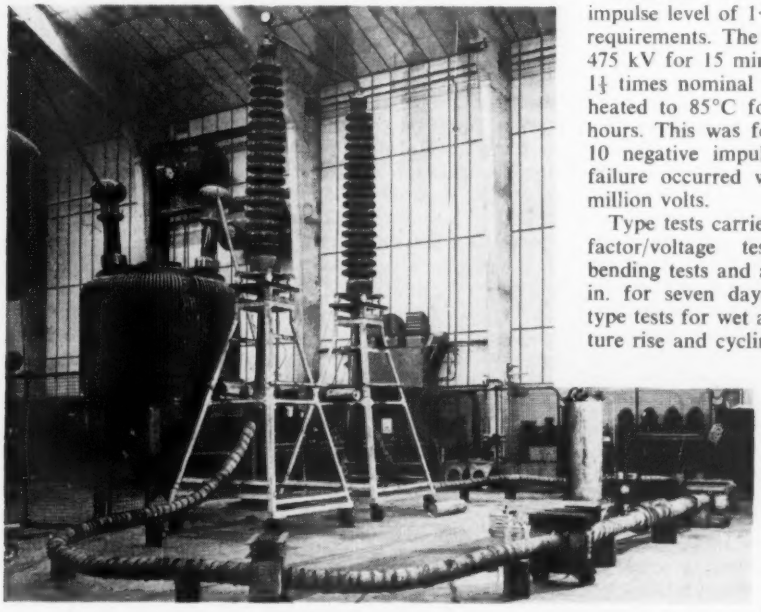
The heading illustration shows the construction of the cable and the great radial thickness of paper insulation used, which is considerably more than on cables previously supplied. The insulating process was carried out in a sealed enclosure in which the atmosphere was closely controlled for both humidity and temperature. Close quality control at all stages during manufacture ensured that the finished cable dielectric was uniform and free from irregular features. The cable conductor consists of high conductivity copper strands with a cross section of 0·85 sq in.

Similar cable sealing ends have been used for outdoor and transformer hall terminations as required by the connection of surge diverters at the transformer terminals. The terminations consist of hand-wound paper and foil cones enclosed in a porcelain bushing so designed that, even if a bushing suffers damage, the paper and foils will have sufficient strength to withstand the full hydrostatic head of 300 lb/sq in. Although the installation has been designed without intermediate joints, a straight joint has been developed and tested for maintenance purposes.

Tests

Cable and accessories were designed to withstand an impulse level of 1·5 million volts to comply with type test requirements. The test consisted of an a.c. voltage test at 475 kV for 15 minutes, two series of 20 loading cycles at 1¼ times nominal voltage; during this test, the cable was heated to 85°C for 8 hours and allowed to cool for 24 hours. This was followed by a series of 10 positive then 10 negative impulse tests at 1.5 millon volts. Eventual failure occurred with a subsequent impulse test at 1·75 million volts.

Type tests carried out on the cable only included power factor/voltage tests, power factor/temperature tests, bending tests and an internal oil pressure test at 375 lb/sq in. for seven days. The sealing ends were subjected to type tests for wet and dry a.c. withstand voltages, temperature rise and cycling tests and porosity of the porcelain.



Heading illustration shows a stepped sample of the 330 kV cable with a central spiral steel duct surrounded by layers of copper wire. Three metallised paper screening tapes are succeeded by graded thickness paper tapes to a wall thickness of 1·1 in. A final screen of metallised paper and copper woven fabric tape is surmounted by the lead alloy sheath, tin-bronze tapes and aluminium wire armouring

◀ *Cable and accessories undergoing loading cycle tests in the high voltage laboratory*

AROUND THE TRADE

BY PEREGRIN

AS we go bravely forward into the unexplored depths of 1960 I am trying to decide how to reconcile my desire to "travel hopefully" with my resolution to "tread delicately." But perhaps all those fine folks who have got a little cross with my remarks over the past year have forgiven me in the season of peace and goodwill and all will be well: and to all those who take the trouble to read my comments "a very happy and prosperous New Year."

What a bumper Christmas it has been with the public in a real buying mood. The housewives' lot was certainly eased in 1959 by more and better electrical appliances and certainly purchase tax cuts enabled them to buy more—although these cuts meant buying at the retailers' expense in many cases. Now I suppose we start on sales to clear the casualties and rejects of the Christmas rush and rack our brains on how best to get rid of items on which we are overstocked, well before the Chancellor of the Exchequer comes along with his Budget axe and lops off some more of our profits. Luckily many of the manufacturers are running a consignment scheme for the higher-priced items, so buying of these need not be too restricted. But that does not take care of the smaller items which may not have sold as we anticipated.

I have heard it argued that complete records over the years make it possible to assess accurately public demand; but this does not always prove true. There is a fashion in these things, a pattern of demand which cannot be assessed, and it is difficult to judge what particular item is going to take the public fancy. During the end of 1959 the weather settled this problem for us, however, and it was clothes driers which topped the bill—spin, heated; cupboard and rack type—they all went. They did not need selling; the public simply came to buy. Well, it's an ill wind, etc., for while I am really very deeply grieved at the damage and misery caused by the heavy rains, I have nevertheless enjoyed the bumper sales.

Municipal Trading

The Chancellor of the Exchequer has announced that the national expenditure on labour-saving appliances has been doubled and we all know that refrigerators were well up in the table of increases. All part of the scheme of things; some have never had it so good! But Rotherham Rural District Council have decided that their council house tenants shall have it even better. With the assistance of the Yorkshire Electricity Board, Morphy Richards-Astral, Main, LEC and Jackson, £32,000 worth of refrigerators are to be installed in these council houses on a 10 year hire purchase scheme. I expect all these manufacturers will give the YEB a fat quantity discount, which they in turn will doubtless share with the Rotherham RDC, who will use it to work the scheme. A plain case of "I'm all right Jack," when one considers the many electrical retailing ratepayers in the district who will be done out of this £32,000 of business, but who will still pay the same rates; or who may even be called upon to subsidise the scheme out of their rates. For whatever scheme of maintenance may be put forward by the supplies it will surely necessitate some sub department, covering maintenance and transport, by the RRDC. One can only hope that all costs, financial, clerical, 10-day exhibition, nearly 6,000 circulars with their attendant replies and postages, will be accounted to the scheme.

Apart from the ethics of municipal trading, it is morally wrong to pledge people to 10 years' credit on such items as refrigerators and quite contrary to national economy. Advocates of municipal trading seem to assume that the trade margin is all profit to the trader, instead of a means of enabling him to give a service to the public, pay his rates, provide a living wage and maybe a little profit to extend a better service. Perhaps the manufacturers might be advised to consider the ultimate effect of the moth and the flame!

I see that Viscountess Lewisham, as guest of honour at the ASEE Ladies' Evening, made a plea that the electrical industry should educate the public to understand what they had to offer—a very commonsense remark, and a very necessary reminder!

The Right Message

Too often, publicity is aimed solely at the pockets of the public without any other thought. The result is that one section of the public buys without fully understanding the equip... and the other section does not buy because it cannot realise what a help it could be to them. Neither aspect is good for sales and so they never reach the peak they should.

There are many items when the "display" advertisement fails completely to get its full message across, although it may be attractively set out: all the public sees is another electrical gadget which does not appear to be worth buying. Dishwashers are a case in point. Quite often more could be achieved by a short, skilfully written article amongst the reading matter in the pages of a woman's weekly or a glossy magazine than in a full page in a leading daily. Of course such articles need to be written by someone skilled in this work and vetted by someone who has tried the appliance and properly assessed its full value and capabilities. So often one sees articles in the dailies or periodicals which are obviously written by a person with a rather sketchy knowledge of electricity and electrical apparatus. I saw one only a few weeks ago in a newspaper in which the public was assured that a particular type of heater rated at 750 watts would give out more heat than a 2 kW fire! Incidentally, I remember some years ago an illustrated series in a weekly paper, one of which showed how to join on extra flex to any electrical appliance by the simple method of twisting the wires together and binding with adhesive tape! Apparently that caused several safety-minded electrical people to act, for the series was promptly withdrawn.

The recent case of a mother being fined for exposing her children to the risk of an inadequately guarded fire reminds one of the necessity for constant observation and preaching the need for safety in manufacture and care and understanding in handling domestic appliances. One could take Lady Lewisham's remarks even more to heart.

I.E.E. ideas on adequacy

SIX OUTLETS AS MINIMUM FOR LIVING ROOMS

IDEAS on housing in the future are set out in replies to an official Ministry of Housing inquiry* made by the IEE Panel on Adequate Wiring for Electrical Installations in Buildings. The inquiry poses a number of questions relating to the planning of homes, amongst them what level of provision of electrical facilities is desirable.

The principal question on electrical topics is phrased: "Please suggest what is the desirable minimum scale of provision for electrical (lighting and power) points." The IEE panel begin their reply by deprecating the implied distinction between lighting and power points, which they suggest has long been made unnecessary by the introduction of "all-in" tariffs. They go on to point to the advantages of the ring-circuit system of wiring, and to express disappointment that the recommendations made in *Post-War Building Studies No. 11—Electrical Installations*, a 1944 publication, have been adopted only rarely in low-cost building. Minimum provision recommended in the study was: living rooms, three s.o.; double bedrooms, three s.o.; single bedrooms, two s.o.; kitchen, three s.o., plus connection for cooker, and another for refrigerator. Additional socket-outlets to be provided for a water heater and for laundring.

More Socket-outlets

Since Study No. 11 was published, there has been a great increase in the number of electrical appliances in use, and the IEE panel emphasise that the 1944 recommendations should be considered as no more than an "absolute minimum standard" suitable for inclusion in any bye-laws that may be promulgated.

Referring to the phrasing of the question they are answering, the panel say they consider the above provision to fall far short of the number that is desirable if the user is to get maximum convenience from the use of electricity. In general—and they admit that there are many considerations special to each individual case—they consider that the number of socket-outlets might well be doubled, and they recommend as a desirable standard the figures given in the table, supporting it by the accompanying list of appliances.

Table I. Provision of Socket-outlets

Kitchen with utility room, if any	6
Living rooms	6
Double bedrooms	5
Single bedrooms	3

Likely Fixed or Portable Appliances

Kitchen: Convector, panel heater or fan heater, cupboard heater, drying cabinet, towel rail, water heater. Boiling ring, breakfast cooker or grill boiler, kettle, mixer, percolator, toaster, warming plate. Clock, refrigerator, dish-washer, garbage disposer, extractor fan, floor polisher, iron, ironer, radio, spin dryer, wash boiler, washing machine.

Living rooms: Convector, panel heater or radiator, fire. Kettle, percolator, toaster, warming plate. Clock, radio, radiogram, television, fan, floor polisher, sewing machine, vacuum cleaner. Table lamps, standard lamps.

Bedrooms: Convector, panel heater or radiator, bedwarmer or electric blanket. Tea maker. Clock, hairdrier, iron, shaver, vacuum cleaner. Table lamps.

In relation to the installation of socket-outlets, the panel recommends that these should be positioned not less than 5 in. and preferably as high as 9 in. above floor level, except in kitchens, sculleries and the like, where the height above floor level should be 4 ft 6 in.

Lighting

For electric lighting, the IEE panel affirm the recommendations made in *Post-War Building Study No. 12*, which calls for two lighting points in the kitchen, and at least one in every other room, with provision for separate illumination of the larder and larger cupboards. It is recommended that switches controlling lighting should be fixed 4 ft 6 in. above floor level, and that those in rooms should be placed not more than 9 in. from the architrave of the door opposite to the hinged side. The bathroom light may be wall-mounted provided it is outside the reach of a person in contact with a fixed bath. If this is not feasible, there should be a cord-operated ceiling switch or alternatively a wall-switch placed outside the bathroom.

Answering other questions, the panel call for more floor space and better planning of kitchens to ensure suitable floor and wall space for electrical appliances. They mention the need to keep in mind the likelihood of new appliances coming within reach of occupiers, for example, home freezers and garbage disposers.

Heating

On trends in home heating, they point to the rapid extension of electric floor-warming systems, but make no mention of block storage systems or other electrical heating techniques. Their answer to a further question about how heating in low-cost dwellings can be improved, again concentrates on floor-warming systems, with the accent on low capital cost. It is suggested that increasing use of electricity for background heating is also helping.

At present, the trend in most houses, so far as permanent background heating is concerned, is considered to involve living rooms, halls and kitchens only, although in the future a trend to have floors of bathrooms and toilets heated is foreseen. Radiant heating seems to be preferred for bedrooms. Thermal insulation is a major factor in improving heating at low cost.

The report elsewhere argues strongly against provision of laundry facilities in the bathroom. The objection is on grounds of safety and also on grounds of the greater space required for storage of electrical laundry equipment. It is not thought that condensation in kitchens need be troublesome. Electrical equipment reduces it, and an electric fan can remove the trouble if it should arise.

* Questionary issued by the Housing Standards Sub-Committee of the Central Housing Advisory Committee of the Ministry of Housing and Local Government.

OVERSEAS NEWS

from our correspondents abroad

CANADA

More Sets for Ontario

Two 300 MW steam turbo-generators for the new Lakeview generating station have been ordered from Associated Electrical Industries of Canada Ltd. by the Hydro Electric Power Commission of Ontario. A substantial portion of the units will be maintained in Canada by the Canadian General Electric Co. at Peterborough under the new agreement between that company and the Canadian subsidiary of AEI in the UK. The first two 300 MW cross-compound sets for Lakeview were ordered from C. A. Parsons and Co. in 1957, for service in 1961 and 1962, and the two additional units just ordered are for commissioning in 1963 and 1964.

Generators for Carillon

For its Carillon power project, the Quebec Hydro Electric Commission has ordered 12 generators from the Canadian General Electric Co. Value of this order has been put at $8½ million. We reported on 17 Dec. last that the order for the 12 associated 60,000 h.p. Kaplan water turbines had gone to the Dominion Engineering Co. of Montreal.

Another Set

Installation of a fourth 45 MW generating set at the Otter Rapids power project has been authorised by the Hydro Electric Power Commission of Ontario. This will complete the first half of the project, the initial plans allowing for the addition of four more sets of similar size at a later date.

Ice Trouble

A freak drop in temperature which brought ice coatings of up to 4 in. thick on power lines and tree branches caused havoc with the transmission lines around Toronto and many areas were without power for several hours. Repair gangs were brought in from as far away as Ottawa by the Hydro Electric Power Commission of Ontario.

St. Lawrence Completed

The sixteenth and final generating unit at the St. Lawrence power plant of the Hydro Electric Power Commission was placed in service last month, marking the completion of the project. Work on the scheme actually commenced less than 5½ years ago, the project being built jointly by the Commission and the New York State Power Authority, who equally divide the 1,880 MW output.

U.S.A.

Japanese Expansion

The Matsushita Electric Industrial Co., one of Japan's leading electrical appliance makers, has set up a new firm in New York as a means of increasing its sales in the United States. The new company is named the Matsushita Electric Corporation of America and has an initial capital of $500,000. This new concern replaces the Maco Electric Co., a joint enterprise between Matsushita and the Imperial Knife Co. of the United States. Their sales in the US have lately averaged nearly $2 million annually but it is planned to at least treble that amount. Among the goods to be sold are transistors, toasters and other appliances.

CHILE

Dollar Loan

A loan of $32½ million for the further development of electric power in Chile is being provided by the World Bank. The main part of the loan is to finance the construction of a 280 MW hydro-electric plant to serve central Chile, the remainder being to assist finance a 15 MW thermal plant in northern Chile. The loan is being made to Empresa Nacional de Electricidad, SA (Endesa) and Corporacion de Fomento de la Produccion (Formento), as co-borrowers. Endesa is a joint stock company, owned almost entirely by Fomento. It was established in 1944 to plan electric power development in Chile and to provide power facilities which cannot be provided by private companies. Fomento is a Government agency responsible for promoting economic development in Chile. Girard Trust Corn Exchange Bank and Grace National Bank of New York are participating in the loan, without the World Bank's guarantee, to the extent of $175,000 representing the first maturity and part of the second maturity which falls due 15 April, and 15 Oct., 1963. Total cost of the two projects is estimated at the equivalent of $72,300,000. The World Bank loan will cover the foreign exchange requirements, and the local currency costs will be provided by Endesa from its own resources and from funds provided by Fomento. All major equipment for the power plants will be procured through international competition. The loan is for a term of 25 years and bears interest of 6%. A new decree law recently issued in Chile provides for electricity tariffs to be relative to invested capital, so that a net yearly profit of 10% shall accrue on fixed assets.

PORTUGAL

Underground Opened

The first section of Lisbon's underground railway system, to which we referred last week, was formally inaugurated by the President of Portugal, Admiral Americo Tomás, on 28 Dec. Total cost of this first stage is put at £2,450,000.

YUGOSLAVIA

More Power

In view of recent power shortages, the inauguration of the several new power plants is being welcomed in Yugoslavia. A new 220 kV line some 180 km in length has just been energised, connected to Bistrica, part of the Kokinbrod hydro power system. Capacity of that station is 104 MW. The Perucica 72 MW hydro plant on the River Zeta in Montenegro, is also about ready for commissioning. Present plans provide for the addition of some 300 MW of plant during 1960. These include a third 17 MW set at Mariborski Otok, commissioning of the Osbalt station on the River Drava with two 20 MW sets and a further 40 MW at Peruca on the River Cetina, near Split. Additional thermal plant will include two 32 MW machines at Kakanj, and two 65 MW sets at the station adjacent to the Kolubara open-cast mine.

RHODESIA

Higher Tariffs Authorised

To clear accumulated losses on the operation of the Southern Rhodesia Electricity Supply Commission, which had reached £1 million by 30 June last and were increasing at a rate of £1,300 per day, the supply tariffs to all centres except Salisbury and Bulayawo are to be increased by 5% as from 1 Feb. next. The increase has been authorised by the Minister of Power, Sir Malcolm Barrow, under the Electricity Amendment Act of 1959. We reported on 26 Nov. that the Southern Rhodesian Chamber of Mines had been granted an injunction against the increased proposals. A firm of consultants has also been engaged to assist in the drawing up of a new tariff structure based on changed conditions when the Commission joins the Kariba scheme.

NEPAL

Agreement Signed

An agreement was recently signed in Kathmandu between India and Nepal under which the Government of Nepal consented to the construction by India of the £39 million Gandak River project in Nepal, which envisages the building of a barrage across the river near Bhalsalotan on the Indo-Nepal border in the Champaran district (India) and the construction of a hydro-electric power station in Nepal territory.

SHANGHAI

Russian Aid

A new 25 MW generating set, obtained from the Soviet Union, has recently been installed in the Wuching steam power station, Shanghai.

AUSTRALIA

Tenders Sought

The Electricity Trust of South Australia is now seeking tenders for the supply of a 3,200 kW turbo-alternator together with its associated boiler plant, for the Nangwarry power station. Also required are 11 kV switchgear, cables, control boards, meters and relays.

Queensland's Outlook

Plans are being prepared for the extension of the Barron River hydro-electric project, Queensland, and it is likely that tenders will be called in the near future, according to Mr J. A. Holt, the Co-ordinator General. Investigations are also being made of possible future hydro-electric schemes on the North Johnstone River and the Upper Herbert River. Mr Neil Smith, the Electricity Supply Commissioner, has just reported that Queensland's electricity requirements are likely to increase more than four times during the next 20 years, and it will be necessary to have at least two new major power stations in service by 1966, one in the southern area and the other to serve the north. He considers it certain that the next major power development in Queensland will be based on the use of coal. Merz and McLellan, the consulting engineers, had almost completed their task of studying the state's power resources, h.v. transmission, and system integration. Mr Smith reported that Queensland's demand for electricity was expected to reach 484 MW by next year, 723 MW by 1965, 1,047 MW by 1970, 1,487 MW by 1975, and 2,089 MW by 1980. The commission had offered its full facilities to Commonwealth Aluminium Corporation to aid the company's investigation into the most economic power source for a refinery to treat Weipa bauxite. The Central Queensland open cut coalfields offered a relatively unique and abundant source of cheap power.

More Hydro

The New South Wales Electricity Commission's first remote-controlled power station, Warragamba, was put into service a few days ago by the Minister for Local Government, Mr P. D. Hills. The 50 MW hydro-electric station on the Warragamba River about 12 miles from Penrith, is controlled from the system control headquarters in Sydney, 50 miles away. The contract for the reaction turbine and alternator was placed with the English Electric Co. Ltd., who have also provided a 62·5 MVA step-up transformer for transmission at 132 kV, auxiliary transformer, station crane and all associated power cables, switchgear, control and communication equipment.

Increased Surplus

Operations of the State Electricity Commission of Western Australia for the year ended 30 June last resulted in a surplus of £90,420, an improvement over the previous period. But that profit came entirely from the Metropolitan area in which over 476·3 million units were sold to 128,712 consumers. The south-west scheme operated by the Commission had a loss of £79,006, plus a deficit of £27,416 on operations by other country undertakings. During the year £1,800,000 was spent on new generation and transmission works, and £1,600,000 on strengthening and extending distribution lines. Peak load on the Metropolitan system reached 138 MW, a 4% increase. In recent years, increase in sales has evened out to between 6% and 7%, and as early plans for extending power station plant had allowed for an annual increase of 10%, there should be excess capacity in a few years unless the rate of increase improves. The second 30 MW set at Bunbury power station was commissioned last June, and two more similar machines are soon to be added. The second Bunbury-Perth 132 kV transmission line is also in service.

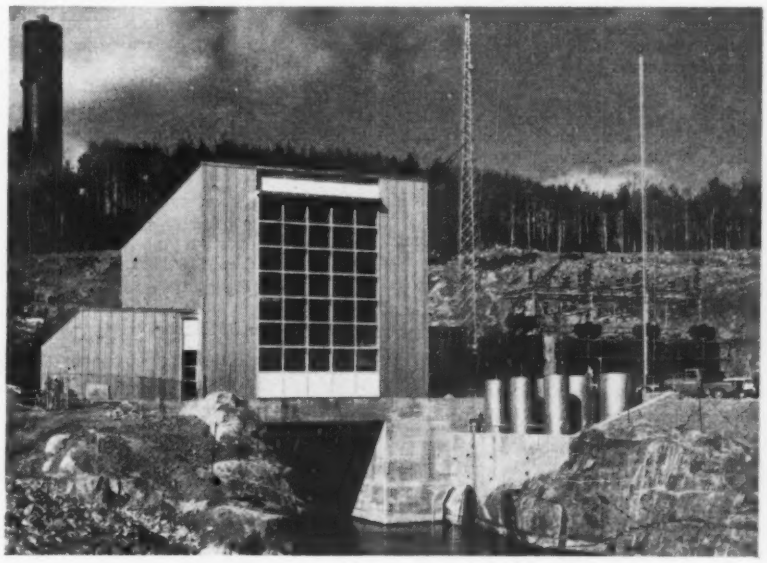
NEW ZEALAND

Plant Wanted

For installation in one of the latest hydro-electric projects planned by the New Zealand Electricity Department, international tenders are now being sought for the supply of three vertical shaft Francis reaction type water turbines, each of 42,000 b.h.p., together with the associated generators.

Wairakei Build-up

The latest turbo-generator recently put on load at the Wairakei geothermal product, to which we referred on 10 Dec. is an 11,200 kW i.p. set (not a 2,500 kW l.p. machine as we reported) the consulting engineers, Merz and McLellan, inform us. More wells are being brought in the load, and the plant has already carried over 41 MW, they state.



This is the recently inaugurated 45,500 kW Silver Falls plant of the Hydro-Electric Power Commission of Ontario. Located on the Kaministikwia River, 30 miles north west of Port Arthur, the plant has only one machine, operating on a head of 338 ft. The turbine was manufactured by Canadian Allis-Chalmers Ltd. and the generator by Canadian Westinghouse Co. The 180 ft high surge tank is seen on the left of our picture. To utilise the 350 ft fall in the section of the river a two-mile-long tunnel was bored through a granite ridge separating Dog and Little Dog Lakes. Water from Dog Lake is diverted through a 900 ft long intake canal, down a 280 ft vertical intake shaft to the tunnel. The 10,400 ft tunnel is connected to the power house by a 500 ft penstock. The station is operated by remote control from the Commission's transformer station at Port Arthur. With its completion, the Silver Falls development increases the Commission's total generating resources in the North Western region to 612 MW

Personalities *in the industry*

Mr C. E. H. Verity

Mr N. J. Ellerbeck

Mr A. H. Young

Dr H. H. Ballin

Mr A. E. Bates

Changes in the board of directors of Foster Wheeler Ltd., effective from 1 Jan., are announced. With the resignation of **Mr G. H. Hopewell,** F.C.G.I., M.I.MECH.E., A.M.I.C.E., M.I.MAR.E., F.INST.F., A.S.M.E., from managing directorship of the company, **Mr C. E. H. Verity,** M.I.C.E., M.I.MECH.E., M.I.E.E., M.I.MAR.E., M.INST.F., A.S.M.E., becomes managing director while continuing as manager of the Steam Division. **Mr R. B. Kerr,** M.B.E., is appointed deputy managing director, and manager of the Process Plants Division. Mr Hopewell remains a director of the company, as deputy chairman and **Mr H. T. Collinswood** has retired from the position of manager, Process Plants Division, but continues as a director of the company. Mr Verity, who joined Foster Wheeler in December, 1955, was previously deputy chief engineer (generation station construction) with the Central Electricity Authority.

Formerly commercial manager of Simms Motor Units Ltd. (with whom he served for 28 years) **Mr N. J. Ellerbeck** has joined Remax Ltd. as deputy managing director. **Mr J. C. Davies,** general manager of Remax, has also been appointed a director of the company.

Mr A. L. Dryer, joint secretary with Mr H. A. Warren of both Power Securities Corporation Ltd. and Balfour, Beatty and Co. Ltd., retired on 31 Dec., after 50 years' service with the Balfour Beatty organisation. **Mr H. A. Warren** has been appointed secretary of both companies with effect from 1 Jan., 1960.

Mr C. T. M. Bagnall, who has been publicity manager with English Electric Co. since 1952, has been appointed to a new post of manager, publicity and information services. This new title carries responsibility for both the company's public relations and publicity departments. The reorganisation follows the retirement of **Mr J. I. Hall** as the firm's public relations officer on 31 Dec., last. Mr Hall remains as a consultant to the group until 31 March, 1960, during which period he will spend some weeks on company business in America and Canada. **Mr M. B. Schroeder** becomes joint deputy publicity manager (technical) and **Mr C. G. Hollowell** joint deputy publicity manager (general). **Mr E. C. Robertson** is appointed deputy to Mr Bagnall on public relations matters, and **Miss Patricia Hardy** becomes chief Press officer.

Mr A. H. Young, A.M.I.E.E., of Troughton and Young (Lighting) Ltd. has been elected chairman of the Lighting Equipment Development Council, in succession to Mr W. T. Souter of Holophane Ltd. The new deputy chairman is **Dr H. H. Ballin,** B.SC., PH.D., F.I.E.S., ASSOCIATE I.E.E., of Atlas Lighting Ltd.

Mr P. Papert, a director of C. J. Fuchs Ltd., of Alberton, Transvaal, is now in Britain with a view to contacting manufacturers of electrical equipment. He is interested in arranging for sole distribution rights for certain domestic appliances and for manufacture under licence of other apparatus.

Mr A. S. MacLellan, LL.D., M.I.MECH.E., has retired from the board of Glenfield and Kennedy Holdings Ltd. **Mr J. H. Lawrence, Mr D. A. S. MacLellan, Mr J. C. Robertson,** and **Mr J. G. Workman** have been appointed to the board of Glenfield and Kennedy Ltd. with effect from 1 Jan.

On retiring as general manager of the Traction Department of the English Electric Co. Ltd. at the end of 1959, **Mr C. M. Cock,** M.I.MECH.E., M.I.E.E., M.I.LOCO.E., has joined the board of Brooke Marine Ltd. as a deputy chairman.

Mr J. J. Finlayson, mechanical engineer (general) at the British Transport Commission's headquarters, has been appointed chief mechanical and electrical engineer, Scottish Region.

After 50 years with the British Thomson-Houston Co., 14 as head of Staff Payroll and Pensions, **Mr A. E. Browne** retired at the end of last year.

From the beginning of this month **Mr A. E. Bates,** M.I.E.E., has taken up a new appointment as manager of the English Electric Co.'s office in Edinburgh, succeeding **Mr W. M. Todd** who was recently transferred to manage the company's Bristol office. Mr Bates joined the company in 1926 in the switchgear drawing office at Stafford. He moved from the switchgear sales and contracts office to Manchester as sales engineer in 1932. He became chief, meter sales and contracts at Stafford in 1937, and then technical sales engineer in London where he has been principally concerned with applications of protective gear equipment and metering. Educated at Regent St Polytechnic, London, he gained a City and Guilds certificate in electrical engineering and completed an apprenticeship with the British Thomson Houston Co. at Willesden.

At a recent meeting of the British Electrical and Allied Manufacturers' Association Export Panel, **Mr D. Maxwell Buist** retired from the chairmanship and **Mr E. V. Small,** joint managing director of Associated Electrical Industries Export Ltd. was elected to succeed him. **Mr L. H. Short,** Director of Overseas Operations, the English Electric Co. Ltd., was elected vice-chairman. Mr Small, on behalf of the Panel members, presented Mr Buist with an inscribed silver cigar and cigarette box and paid tribute to him, not only as the Founder and Chairman of the Panel since 1948, but also for the way in which he had co-ordinated the export activities of BEAMA members which had resulted in the Panel being now recognised as one of the most important bodies within the BEAMA organisation.

Mr D. Maxwell Buist has also resigned from the chairmanship of the BSI/CSA Advisory Committee (which relates to the approval in advance of electrical goods for Canada), and has been succeeded in that position by **Mr W. L. Sims,** an assistant managing director of Wadkin Ltd. Mr Sims was one of the original members of the mission

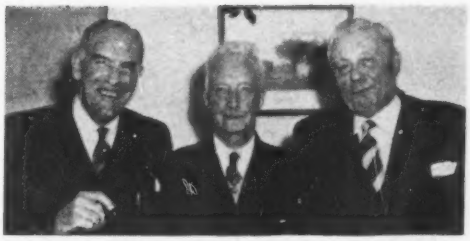
organised by the BSI which went to Canada in 1949 to arrange the present scheme.

Sales manager of the Rawlplug Co. Ltd. for more than 14 years, **Mr J. Lawrence Stocks** has retired. His successor is **Mr P. D. Northover** who has been with the company for nearly 14 years and who has acted as a technical representative in the north of England. **Mr L. Unwin,** manager of the Sales Order Department, has been promoted to assistant sales manager to Mr Northover.

From this month, a new department of the Admiralty—the Navy Works Department—has come into being. First director-general of Navy Works is **Mr W. G. Harris,** M.A., M.I.C.E., the former civil engineer-in-chief. He will be assisted by three Directors of Navy Works, **Mr C. F. Marshall,** B.SC., M.I.C.E., **Mr J. W. Hunter,** B.SC., M.I.C.E., and **Mr F. B. Allcock,** B.SC., M.I.E.E., the latter being responsible for the electrical and mechanical engineering work in the new department.

Director and general works manager of Hoover (Australia) Pty. Ltd., since 1955, **Mr P. C. Raphael** is in Britain for a stay of nearly two months.

London Transport announces that **Mr R. T. Gladwin,** B.SC.(ENG.), M.I.C.E., and **Mr J. B. L. Hoban,** B.A., B.ENG., A.M.I.C.E., both senior executive assistants in the office of the new works engineer, Department of the Chief Civil Engineer, have been appointed principal new works assistants. Mr Gladwin was educated at Wycliffe College, Glos, and at University College, London, where he obtained a B.Sc. degree in engineering with first class honours in public works, geology and municipal hygiene. He was employed for three years with public works contractors and joined London Transport as a general technical assistant in the office of the new works engineer in 1948. In 1956 he was promoted to senior executive assistant and is at present the senior resident engineer in charge of the new works on the Metropolitan Line. Mr Hoban was educated at the Grammar School, Galway, and at Trinity College, Dublin, and has had experience with consulting engineers and with the Air Ministry Works Directorate. Mr Hoban joined London Transport in 1957 as a senior executive assistant in the office of the new works engineer in charge of civil engineering design work.



After the Eastern Board's retirement presentations. Left to right, Mr J. E. Blair, Mr T. Hardwick, and Mr H. G. F. Gamble

Three presentations were made to retiring members of the staff at Eastern Electricity Board's Christmas dinner at h.q. Those concerned were **Mr J. E. Blair,** chief accountant, **Mr H. G. F. Gamble,** the assistant chief commercial officer in charge of sales service and contracting and **Mr T. Hardwick,** the caretaker. The presentations were made by the chairman of the board, **Mr H. V. Pugh.**

The General Products Group of the General Electric Co. has been reorganised into five new groups (to which we refer on page 29), each under the control of a group managing director. The groups and their managing directors are: Domestic Equipment, **Mr E. A. Fowler,** M.I.E.E., F.I.E.S.; Installation Equipment, **Mr R. H. Phillips,** T.D., ASSOCIATE I.E.E.; Lighting and Heating, **Mr D. L. Tabraham,** M.A., F.I.E.S.; Osram Group, **Mr A. E. Page;** and Radio Group, **Mr M. M. Macqueen.** Mr E. A. Fowler, who joined GEC in 1955 became general manager, northern England, in Nov., 1958. He has been closely associated with reorganisation work and commercial administration at head office. Before joining the company he was chief commercial officer of the Eastern Electricity Board from 1949, having previously served as a member of the managerial executive of the Yorkshire Electric Power Co. group from 1938. While with the Eastern Board Mr Fowler served for several years on the Union Internationale des Producteurs et Distributeurs d'Energie Electrique Utilisation Committee as a Representative Delegate for the BEA. He has served for many years on committees of EDA, and was vice-chairman of the North Midland Centre of the IEE in 1947-48, having previously served as chairman of the Utilisation Section of the Centre in 1947. He is also vice-chairman of the East Anglian Sub-Centre Committee. Mr R. H. Phillips joined GEC in 1926 at Witton and transferred to the sales side of the company in 1928. In 1939 he became manager of the Installations Materials Department at Birmingham. After war service in 1946, he was appointed manager of the Leicester branch and in 1949 became assistant manager of the Midlands area. Mr Phillips was appointed area manager—his present position—in 1957. An ordinary member of the council of the IEE, Mr Phillips was honorary secretary of the Institution's South Midland Centre from 1949 to 1954. Mr D. L. Tabraham, after graduating at Cambridge, joined GEC Research Laboratories in 1937 as a trainee in the illuminating engineering section. On completion of training he transferred to the Illuminating Engineering Department at head office. At the end of 1940 he was appointed manager of the Lighting Department for the north east area, but was later seconded to the Admiralty. Mr Tabraham rejoined GEC in 1946 and held his former position until 1949 when he returned to head office. He was appointed manager of the Lighting Fittings Department there in 1951 and six years later was made manager of the newly formed Lighting Division which comprised the Lighting Fittings and Exterior Lighting Departments. Mr Tabraham is president of the Electric Light Fittings Association and a vice-president of the Illuminating Engineering Society. He is also a member of the Electrical Fair Trading Council. Mr A. E. Page joined the GEC in 1915. He was appointed assistant manager of Osram Lamp Department in 1930, sales manager in 1946 and took over full management of the Department in 1954 on the retirement of the late Mr W. H. Williams. For many years, he was associated closely with the work of the ELMA, being chairman of the council in 1955. He is also the immediate past-chairman of the Electric Lamp Industry Council. Mr Page was intimately concerned with the Lighting Service Bureau and played an active part in the formation of its successor, the British Lighting Council of which he is the

Mr E. A. Fowler

Mr R. H. Phillips

Mr D. L. Tabraham

Mr A. E. Page

Mr M. M. Macqueen

Mr F. W. H. Shaw

Mr F. S. H. Lemon

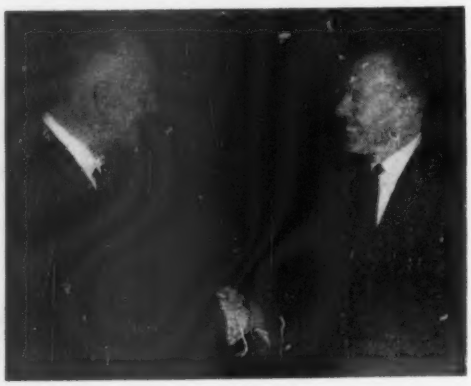
Mr L. C. J. Carvill

Mr E. C. Merrick

Mr E. H. French

present chairman. When the Osram Lamp Division was formed in 1958, uniting the commercial and manufacturing responsibilities, Mr Page became its first general manager. He is a director of a number of associated companies of the GEC including Glass Bulbs Ltd., Lamp Caps Ltd. and British Sealed Beams Ltd. Mr Macqueen was educated at Bellahouston Academy, and after a brief period in the Glasgow City Surveyor's Department joined the Royal Navy in 1916. On demobilisation he studied law at Glasgow University, and in 1921 joined William Beardmore and Co. In April, 1923, he came to London to become assistant to the manager of the GEC's newly formed Radio Department, and in 1930, when he was appointed manager, he was only 32 years old. From the start Mr Macqueen has been widely connected with radio trade associations. He became chairman of the Radio Manufacturers' Association in 1937, and has held this office several times subsequently. A council member of BREMA since its inception, he was also an original member of the Radio Industry Council executive. During the last war Mr Macqueen was on the Advisory Committees to the Ministries of Aircraft Production and Supply. In 1946 he joined an industry delegation which went to India to advise the then Government on the development of its broadcasting system. Mr Macqueen at the present time serves on a number of committees concerned with the broadcasting industry.

Mr H. Melhuish, assistant managing director of the Superheater Co., has retired. He will remain a director of the company.


Mr H. M. Medhurst, right, receives good wishes from Mr J. B. Wormall (industrial sales director of LSE) on his retirement

Mr F. W. H. Shaw has been appointed managing director of Submarine Cables Ltd. He succeeds **Mr F. S. H. Lemon,** O.B.E., who has retired after over 40 years' service. Mr Shaw was, earlier, assistant engineering director of Siemens Edison Swan Ltd. before joining Submarine Cables Ltd. in Jan., 1959, as deputy managing director. He was general cable manager of Siemens Brothers and Co. from 1953 to 1955. With that concern he was assistant to the cable works manager from 1938 to 1946 when he became chief cable engineer, a post he held till 1953. Mr Lemon started his career with the Telegraph Construction and Maintenance Co. and after a five-year apprenticeship, was on the electrical testing staff on the company's ships for 16 years. He then served as chief estimator at the Greenwich works for 12 years, and afterwards took charge of the Erith factory from the commencement of production of the transatlantic telephone cable. He became managing director of Submarine Cables Ltd. in 1956.

Mr L. C. J. Carvill, M.P.O.A., has been appointed supervisor of purchases, AEI (Rugby) Ltd., succeeding **Mr O. A. Pallett** who continues with the company in a consultative capacity. Mr Carvill served a BTH apprenticeship and transferred to Works Buying Department, being appointed head of this department on 3 Jan., 1949. He moved to Central Purchasing Office on 3 May, 1954, as personal assistant to the supervisor of purchases, and was promoted deputy supervisor two years ago.

Sales engineer at the London office of Laurence, Scott and Electromotors Ltd. for the past 23 years, **Mr H. M. Medhurst** has retired. Earlier he was with the Lancashire Dynamo Co. for 27 years, having served an apprenticeship at the Crypto Works and gaining technical education at Finsbury (City and Guilds) Technical College in the days of Dr Silvanus P. Thompson. To mark his retirement, Mr Medhurst was presented with a cocktail cabinet by his colleagues.

AEI (Rugby) Ltd. announce the appointment of **Mr E. C. Merrick,** A.C.G.I., A.M.I.E.E., as manager of the Education Department, to succeed **Mr C. Grad** who has been seconded to other duties in connection with education within AEI. Mr Merrick joined BTH in 1927 as a student apprentice, and transferred to Construction Department, Rugby Works, in 1931, being engaged in the erection of switchgear in the North of England. A year later he joined Production Control Department in the Motor Factory Rugby and in 1934 was appointed assistant to the planning engineer. He became chief planner, Fabrication Factory, in 1936, assistant chief inspector in 1940 and chief inspector 1942. After a period as superintendent at the Larne Works, Northern Ireland, he returned to the Midlands as apprentice training supervisor, Electronics Group, Leicester. In May, 1959, he was appointed assistant manager, Education Department, Rugby.

Sir William Penney, K.B.E., of the UKAEA, is among six newly-elected vice-presidents of the Royal Society.

Sir Maxwell Inglis, Bt., has been appointed a part-time member of the South of Scotland Electricity Board and chairman of the area Electricity Consultative Council for the period until 31 Dec., 1962, in place of the late Councillor John Sullivan (*ESH, page 155).

Mr E. H. French has been appointed head of staff payroll and pensions, AEI (Rugby) Ltd. in succession to **Mr A. E. Browne** who retired at the end of December last.

Mr F. P. Laurens, O.B.E., M.I.MECH.E., M.I.PROD.E., assistant managing director, production, of International Computers and Tabulators Ltd., has resigned from the board of directors of Vickers-Armstrongs Ltd. with effect from 31 Dec., 1959.

Having held the office of hon. secretary of the Supply Group of the IEE Western Centre, **Mr F. F. Freeling** has retired from that position. It is proposed to show appreciation of his valuable services by making a presentation early this year, and Mr H. Jackson, B.SC.(ENG.), M.I.E.E., the Centre's chairman invites subscriptions of up to 5s.

** Denotes revision to the "Electricity Supply Handbook, 1959."*

Mr A. J. W. Green, who was elected to the main board following the Braby/Auto Diesels merger, has been appointed joint managing director for the Frederick Braby group of companies from 1 Jan., 1960.

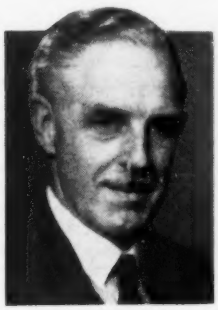
Formerly works manager of the Motherwell works of the Metropolitan-Vickers Electrical Co. Ltd., **J. E. A. Heale** has been appointed to a new post with AEI (Woolwich) Ltd. His successor at Motherwell is **Mr E. Turnbull** (not E. Campbell as we stated on 24 Dec.).

Alderman E. Simms retired from the South Eastern Electricity Board on 31 Dec., after 12 years as a part-time member—he has been a member of the board since its formation. (*ESH, page 79.)

Having just retired from the position of manager of the Norfolk sub-area of the Eastern Electricity Board, **Mr J. A. Sumner,** M.I.E.E., M.I.MECH.E., F.B.I.M., has announced that he is proposing to stand as an independent candidate in the Norwich City Council elections next May.

Mr J. W. E. Stanley has retired as managing director of Plibrico Co. Ltd., but remains a director. He is succeeded as managing director by **Mr D. E. Huntley.**

Dr P. Dunsheath, C.B.E., M.H., D.SC., D.ENG., M.I.C.E., M.I.E.E., and **Sir Alexander Sim,** C.A., have retired from the board of directors of W. T. Henley's Telegraph Works Co. Ltd. at the end of December. Sir Alexander Sim is succeeded as chairman of the company by **Dr J. N. Aldington,** B.SC., PH.D., M.I.E.E., F.R.I.C., F.INST.P., F.I.E.S. Dr Dunsheath joined Henley's in 1919 after experience as assistant engineer to the GPO. After ten years as director of research he became chief engineer in 1929, was appointed director and chief engineer in 1937, and from 1946 has been a director and consulting engineer. A past-president of the IEE, of EDA, and the International Electrotechnical Commission, he has also been a member of the London Electricity Board. He remains chairman of the Convocation of the University of London. In 1951 he led a Productivity team to the USA to study the relations between American Universities and industry. Within the Henley organisation he founded the Henley Education Scheme some 20 years ago, and has been actively engaged, as chairman of the Education Committee, in its development. Sir Alexander Sim, who became chairman of Henley's in June, 1958, succeeding the late Sir John Dalton, only joined the company a year previously, having earlier been in India as chairman of Andrew Yule and Co. and president of the Association of Chambers of Commerce of India and of the Bengal Chamber of Commerce and Industry. Sir Alexander Sim has also resigned as director of the subsidiary and certain associated companies. While chairman of Henley's he completed the complex negotiations which resulted in the firm's integration with AEI.



Dr P. Dunsheath

Sir Alexander Sim

Sir John Erskine, G.B.E., D.L., J.P., has been appointed deputy chairman of the North of Scotland Hydro Electric Board for the next two years, in succession to the late Sir Hugh Mackenzie, C.B.E. (*ESH, page 163.)

Marine manager of Allen West and Co. Ltd., **Mr J. M. L. Slater,** M.I.E.E., M.AM.I.E.E., retired at the end of December after 60 years' service in the electrical engineering industry. He gained experience of mechanical engineering before becoming an electrical draughtsman in 1903. Three years later he joined the engineering staff of the British Westinghouse Co. at Trafford Pk, where he remained until 1918. For the next four years he was with the Admiralty at Whitehall in charge of switchgear and control gear design under the Director of Electrical Engineering. He represented the Admiralty on the BSI and continued his membership until 1926. Mr Slater joined Allen West and Co. in 1927. His successor as manager of the latter's Marine Department is **Mr G. H. Page** who has been deputy to Mr Slater for more than 20 years.

Until recently chief engineer of Fischer and Porter Ltd., **Mr B. A. Worswick,** B.SC.(HONS.), A.INST.P., has joined Elcontrol Ltd., as technical director, with a seat on the board.

Lord Chandos, chairman of Associated Electrical Industries Ltd., leaves London by air today, 7 Jan., on a visit to India. He has been invited by the Indian Government to see some of the important projects in which Britain is helping industrial developments there, taking in Bombay, Bhopal, Agra, Delhi, Patna, Durgapur and Calcutta. He expects to return on 2 Feb.

Deputy chief accountant of the Yorkshire Electricity Board since Dec., 1948, **Mr E. W. Raby,** F.I.M.T.A., F.S.A.A., is retiring on 31 Jan. next. He will be succeeded by **Mr A. Dent,** D.P.A., F.S.A.A., A.I.M.T.A., the board's organisation and methods officer. (*ESH, page 134.) Earlier, Mr Dent was an assistant chief accountant with the board, which he joined in April, 1948, after being deputy borough treasurer at Ipswich.

Earlier with Ambassador Radio and Television Ltd., **Mr R. Marland** has been appointed manager of the new Domestic Appliances Division of Telefusion Ltd.

Mr R. G. W. Andrews, right, works manager of Venner Ltd., receiving a presentation from Mr E. Tauchert, managing director, in recognition of his 39 years' service

Mr A. E. Kay has been appointed a director of the London Electric Wire Co. and Smiths Ltd. as from 1 Jan.

OBITUARY

Mr W. Dixon, M.I.E.E., M.I.MECH.E., M.INST.MET., F.INST.F., senior partner at the Newcastle upon Tyne office of Merz and McLellan, died on 31 Dec., aged 71. He had been a partner since 1937, having started with the firm as a junior engineer in 1911. He was closely connected with many electricity supply developments in the London area and abroad, and was chairman of the IEE North Eastern Centre in 1945-46.

Mr C. Stern, managing director of Rotaflex of Canada, died in London on 1 Jan.

British Standards

Mechanical Testing of Steel. *B.S. 3082: 1959. Parts 3 and 4. Price 4s each.* Of two new standards relating to the creep testing of steels, the first (Part 3) deals with non-interrupted, and the second (Part 4) with interrupted testing. They lay down the parameters of test methods to determine any creep, or permanent change in dimension, as a result of recurring or non-recurring stresses at elevated temperatures.

B.22 bayonet cap lampholders of moulded insulating material. *Supplement No. 1 to B.S. 52:1952. PD 3559. Price 5s.* Applying only to insulated lampholders suitable for g.l.s. lamps, this supplement is an important document, having as one of its objects the interchangeability of parts, notably shade carrier rings. For this part, a screw thread of 18 t.p.i., and Whitworth form, has now been specified. A second object of the supplement is to introduce suitable tests for quality of design and manufacture. Such tests include dimensional stability, durability and strength in service and security of cord grip. Since the new designs are a radical change from many existing designs, their production will call for major changes in manufacture and, for this reason, the supplement will not come into force for at least two years.

NEW YEAR HONOURS

Sir George Nelson—Baron

Mr E. J. Lockwood—Kt

Mr L. J. Davies—CBE

Mr E. J. Timberlake—OBE

Mr A. J. Nicholas—CBE

WHILE the New Year Honours List may not be quite as extensive as usual, it includes a number of individuals well known throughout the Electrical Industry. First award to be noted concerns **Sir George Nelson,** LL.D., F.C.G.I., HON.D.I.C., M.I.MECH.E., M.I.E.E., chairman of the English Electric Co. Ltd., who becomes a baron. A past-president of BEAMA, of the IEE and the ERA, Sir George was Knighted in 1943 for his services to the Ministries of Aircraft Production and Supply.

Among those who receive a knighthood are **Mr J. F. Lockwood,** chairman of Electric and Musical Industries Ltd. and **Mr H. B. Waring,** D.L., chairman and managing director of Joseph Lucas.

The new chairman of the UK Atomic Energy Authority, **Sir Roger M. Makins,** who was formerly joint permanent secretary, HM Treasury, is awarded the G.C.B. while among those who receive the C.B.(Civil) is **Mr E. J. Meadon,** under-secretary and accountant-general, Ministry of Power.

Sir Ian Jacob, K.B.E., C.B., who has just retired as Director-General of the BBC, is promoted to G.B.E., and the award of the K.B.E. is made to **Mr R. J. P. Harvey,** C.B., M.A., deputy director-general of the GPO.

C.B.E.

In the list of recipients of the C.B.E. are the names of **Mr D. D. Cruikshank,** E.D., general manager, Renfrew, Dalmuir and Dumbarton Works of Babcock and Wilcox Ltd., **Mr L. J. Davies,** M.A., B.SC., M.I.E.E., director of research and education at the BTH Research Laboratory, Rugby, and a director of the BTH Co.; **Mr I. Michaels,** under-secretary in charge of Atomic Energy Division, Ministry of Science; **Mr A. J. Nicholas,** O.B.E., A.M.C.T., M.I.E.E., managing director of South Wales Switchgear Ltd., and joint managing director of Aberdare Holdings Ltd., who has been concerned in many switchgear developments, and is keenly interested in the educational side of industry; **Mr F. Williams,** B.SC., M.I.E.E., controller, sound broadcasting engineering, BBC; and to **Brig C. A. Zweigbergk,** M.SC.TECH., M.I.E.E., of Ministry of Aviation electrical inspection directorate.

O.B.E.

Recipients of the O.B.E. include **Mr T. Barlow,** resident engineer at the Windscale works of the UKAEA; **Mr A. W. H. Cole,** manager, Communications Division, Marconi's Wireless Telegraph Co. Ltd., **Mr P. G. Horsler,** M.C., HM Superintending Inspector of Factories, Ministry of Labour, **Mr W. K. MacKenzie,** deputy regional director, Midland Region, GPO; **Mr E. J. Timberlake,** ASSOCIATE I.E.E., joint managing director of the Electro Dynamic Construction Co. Ltd.; **Mr J. E. Whittaker,** B.SC.(ENG.), M.I.E.E., ASSOC.I.MECH.E., who has been manager of the Aberdeen area of the North of Scotland Hydro Electric Board for the past nine years, and earlier, was assistant city electrical engineer of Aberdeen; **Mr E. T. Wilkins,** a principal scientific officer with the DSIR; **Mr A. Wilson,** principal executive officer, lately Regional Director (North Western Region), Ministry of Power, and **Mr F. J. Brewin,** A.M.I.E.E., lately principal inspector, Ministry of Aviation.

M.B.E.

The lengthy list of those who received the M.B.E. includes **Mr A. Allen,** chief development engineer, Cossor Radar and Electronics Ltd.; **Mr W. Atkinson,** D.C.M., M.M., B.E.M., electrical engineer, War Office; **Mr N. Berryman,** chief National Savings Liaison Officer for the Electricity Supply Industry; **Mr A. G. W. Cannon,** Divisional Manufacturing manager, AEI Rugby; **Mr F. N. Chadwick,** higher executive officer, London Communications Electronics Security Agency; **Mr R. W. Chandler,** chief telecommunications superintendent GPO; **Mr J. V. Cross,** mechanical and electrical engineer; Air Ministry Directorate-General of Works, London Airport; **Mr Alec Draper,** B.SC.(ENG.), M.I.E.E., who is vice-principal Rugby College of Engineering and Technology; **Mr L. G. Fowell,** executive engineer and general manager, Pye Ltd., West Drayton; **Mr M. H. Hall,** engineer-in-charge, Television Studios, BBC; **Mr E. J. Hocking,** electrical manager, Vosper Ltd., Portsmouth; **Mr W. H. Hughes,** A.C.C.S., assistant chief financial officer to the South of Scotland Electricity Board; **Mr W. J. Marshall,** A.M.I.E.E., senior executive engineer, Engineer-in-chief's Office, GPO; **Mr N. G. Payne,** A.M.I.E.E., engineer-in-charge, Independent Television Authority's transmitting station, Hints, Tamworth; **Mr W. G. D. Phillips,** senior executive officer, Ministry of Power; **Mr G. H. Prince,** head of Apparatus Engineering Department, Ericsson Telephones Ltd., Nottingham; **Mr J. Ringland,** assistant manager, Electrical Department, Harland and Wolff Ltd., Belfast; **Mr J. H. W. Simmons,** senior principal scientist, Atomic Energy Research Establishment, Harwell; and **Mr T. A. Yates,** electrical engineer, Admiralty.

B.E.M.

Those awarded the B.E.M. include **Mr N. Caffrey,** chargehand electrician's mate, Royal Ordnance Factory, Chorley; **Mr W. Gaddes,** foreman fitter, Carlisle power station; **Mr W. S. Harffey,** general foreman, Eastbourne district, South Eastern Electricity Board; **Mr J. Law,** senior installation inspector, North Eastern Electricity Board, York; **Mr W. T. Robinson,** fitter (mechanical), Dunston "B" power station; **Mr E. Taylor,** foreman, Automatic Telephone and Electric Co., Liverpool; and **Mr W. Thompson,** foreman meter-reader and collector, Yorkshire Electricity Board, Leeds.

OVERSEAS

Among overseas recipients of awards are **Mr A. W. Knight,** chief commissioner of the Hydro Electric Commission of Tasmania, who receives the C.M.G., while the C.B.E. goes to **Mr John Sharples,** B.SC.(ENG.), M.I.E.E., general manager and deputy chairman of the Central Electricity Board of Malaya; **Maj W. Stubbs,** M.C., M.I.E.E., director-general of telecommunications, Federation of Malaya, and to **Mr C. A. McFarlane,** director-general, Posts and Telegraph Department, New Zealand. The operation of the Kariba hydro-electric project is also recognised—**Mr D. L. Anderson,** C.B.E., T.D., chairman of the Federal Power Board of Rhodesia and Nyasaland, is awarded the K.B.E., and the O.B.E. goes to **Mr T. K. A. Douglas,** B.SC., M.I.E.E., specifically "for services rendered in connection with the construction of the Kariba Dam."

Alumina Powder for Canned Components

A NEW approach to the protection of electronic components was revealed recently by engineers of Bell Telephone Laboratories, USA. They described how alumina powder (aluminium oxide) can be used successfully to insulate, or "pot" transformers and other electrical components within hermetically sealed cans, replacing the more conventional semi-fluid materials such as mineral-filled asphalts which have been used in the past.

In the many applications where electronic and electrical components must have extra protection from extremely humid environments, a common practice is to seal them hermetically inside a metal can. However, when the component is enclosed in this way, its internal temperature is so increased that the life of the device is seriously reduced. Use of a filling to conduct heat to the surface of the can helps, and conventional potting compounds applied for this purpose include mineral-filled asphalts such as sand asphalt. This has good heat transfer properties, but it melts at the relatively low temperature of 135-150°C (275-300°F). When it melts, it expands, threatening the hermetic seal and the component.

Alumina powder does not show these disadvantages. Its melting point is above 1,500°C (2,700°F), well above the operating temperatures of any electrical apparatus. It does not expand or contract to any noticeable extent under wide fluctuations of temperature, so no strains are imposed on the component. Also, it does not need to be cured or vulcanised for use, as some of the plastic potting compounds do and thus the strains which can develop from these processes are absent.

The powder possesses another advantage over asphalts, epoxy resins, and other similar potting compounds, in that it maintains its dry, granular form in use. The electrical component can be removed for inspection or repairs at will, simply by breaking the seal on the can and pouring out the powder.

Alumina is completely inert. Thus, there is no fire hazard, either during potting operations or in use, in contrast to inflammable asphalts or resins. Since alumina is stable to such high temperatures, it can be used as a single potting compound to cover the gamut of temperature ranges.

The preferred physical form of the alumina is spherical. In this shape, the granules pack well, but do not have the abrasive characteristics of more irregular shapes. Material of this type is understood to be readily available at prices which are competitive with conventional materials.

The test programme on alumina potting compounds was performed on typical, medium-sized electronic power transformers, which were impregnated with a polymerising varnish before potting and encasing.

A paper describing this use of alumina has been read to a US conference on the Applications of Electrical Insulation by L. W. Kirkwood and R. S. Kay, engineers of the Bell Telephone Laboratories, USA. The first practical application of the material was made by H. S. Feder, also of the Bell Telephone Laboratories.

INTRODUCING THE "ESTATE" COOKER

AT a Press preview on 4 Jan. at Charing Cross Hotel, W.C.1, the Electrical Division of Radiation Ltd. showed the new models of Jackson electrical cookers which will become available in the first months of 1960. Perhaps the most significant feature is the universal adoption of the high loaded, sealed-in type hotplates on all models, even the low priced "Estate" cooker which, at the modest price of £28, should do much to popularise electric cooking on the housing estates which are occupied by families in the lower income group.

The "Estate" cooker is of orthodox design with full width oven door, six-heat control switches for the 8 in. 2 kW and 6¼ in. 1·35 kW plates, three-heat control for the 10½ in. by 8 in. grill boiler and thermostat for the large oven, grouped either side of the under-hob hot-cupboard. Heating of the oven is by side elements of the tubular sheathed pattern behind removable, vitreous enamelled combination element guards and shelf supports. A cold cupboard in the base can be supplied for £2 extra and an oven timer for a further £5. Standard finishes are white or cream.

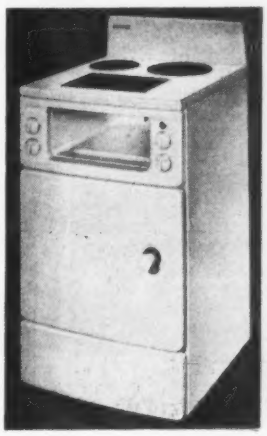
The new "Highline" models, all with eye-level grill and with the sealed-in hotplates, incorporate new features, notably the reduction of hob height from the previous "standard" of 36 in. to 33¼ in. The two basic models are the 493 with three hotplates and the 494 with four hotplates, in each case one being the 8 in. VHS plate with six-heat control. Glass oven doors are standard equipment on both models with an interior light to the 494. The hot-cupboard in the base is particularly commodious and is separately heated, being equipped with a rugged wire basket to hold the crockery, etc. Controls are grouped along the front of the cooker below the hob with the exception of the auto-timer which, when provided, is mounted on the splash plate.

Prices are encouragingly low, the basic model 493 being listed at £45 or, with oven timer, £51. The 494, complete with timer, is listed at £56 and is probably the lowest priced four-plate cooker on the British market today. This is partly through the adoption of a system of manufacture which dispenses with a separate frame structure and is, in effect, an assembly of major components into a unit of great mechanical strength.

A point which is often omitted on electric cookers is the provision of levelling screws to compensate for uneven floors. All of these models have these levelling screws.

A useful extra is a mobile plinth which raises the hob-level to 36 in. and enables the cooker to be easily moved from the wall. Price is £3.

The new models will not be available for a few weeks yet but, as soon as production has built up a satisfactory stock to meet initial demands, a Press advertising campaign will be launched which will cover National Press, women's magazines, trade and technical press as well as ITV television advertising.



Left. The Jackson 391 "Estate" cooker with high speed hotplates and grill boiler. Price £28

Right. The 494 "Highline" with four sealed in hotplates, eye level grill and auto-timer. Price £56

PLANT INSTALLATION, 1959

The Year's Commissioning in Power Stations

COMMISSIONING of generating plant by the CEGB in 1959 made a sharp improvement on the relatively small figure for 1958, as the table below shows. Twenty-one turbo-alternators with an aggregate installed capacity of 1,775 MW were installed, and 23 boilers with total steam raising capacity 14,700 klb/hr, 15 power stations were concerned in this work, five of these were new stations and two were new sections. The five new stations are Belvedere, Drakelow 'B', Elland, High Marnham and Little Barford 'B'.

Output capacity of the new plant is estimated at 1,670 MW, which compares with 1,154 MW for 1958. In addition to the plant listed in the table, there were three boilers commissioned which made no contribution to output capacity because their associated turbo-alternators have not yet been commissioned. The stations concerned were Northfleet, a station still to be commissioned, and having an 860 klb/hr boiler by Foster Wheeler; South Denes, where No. 4 (Mitchell) boiler rated at 550 klb/hr was commissioned; and Spondon H, where boiler No. 24 rated at 180 klb/hr (Foster Wheeler) was completed, but not put on the steam range.

Most of the new plant has been noted in our monthly survey of power supply statistics, but there are some sets and boilers which were installed in the December commissioning rush. One of these four sets was installed at Belvedere, Bold 'B', Drakelow 'B' and Spondon 'H', respectively.

Scottish Commissioning

In Scotland, apart from another instalment at the Kincardine station of the South of Scotland EB, the year has been one of relatively small hydro sets. The only units to make double figures in MW ratings were those at Cashlie, Orrin and Shin. Otherwise the installation record reflected the manner in which the North of Scotland HEB makes the most of the hydro potential of its schemes even where this involves installing small sets of only a few hundred kW rating.

Set Sizes

Outstanding feature of the year's commissioning so far as the CEGB is concerned is the successful bringing into operation of the first 200 MW set, at High Marnham. This marks the pattern of commissioning in the future, although the 60 MW sets which figure in the list below will continue to appear until the stations started some years back reach their planned capacity. The 100 MW straight sets will continue for some time as well, although they have been largely overtaken in future programmes by the 120 MW sets incorporating reheat.

The increase in the CEGB's installed capacity during the year of 1,775 MW brings their total installed plant capacity to about 27,250 MW, although it should be noted that this figure may be slightly modified to allow for derating of plant during December.

The trend to increased boiler ratings is clear from the plant commissioned during the year. Only one boiler has a rating of less than 200 klb/hr, and this has been installed in a station providing large quantities of process steam. All the remaining installations are rated over 500 klb/hr and include the large 1,400 klb/hr boiler for the High Marnham 200 MW set.

NEW PLANT COMMISSIONED IN BRITAIN, 1959

Station	Division (Project Group)	Alternators			Boilers		
		No.	Rating MW	Maker	No.	Rating klb/hr	Maker
CEGB							
Agecraft 'C'	North Western (Northern)	1	120	A.E.I.	1	860	International combustion
Belvedere	London (Southern)	3	60	E.E.C.	3	550	John Brown
Blyth 'A'	North Eastern (Northern)	2	120	A.E.I.	2	860	Babcock and Wilcox
Bold 'B'	N.W., M. and N. Wales (Northern)	1	60	G.E.C.	1	550	John Thompson
Castle Donington	East Midlands (Midlands)	1	100	A.E.I.	1	830	Babcock and Wilcox
Drakelow 'B'	East Midlands (Midlands)	2	120	Parsons	2	860	I.C./Foster Wheeler
Elland	Yorkshire (Northern)	2	60	A.E.I.	2	550	Yarrow/J. Brown
Ferrybridge 'B'	Yorkshire (Northern)	1	100	Parsons	1	760	Babcock and Wilcox
High Marnham	East Midlands (Midland/Northern)	1	200	E.E.C.	1	1,400	International Combustion
Little Barford 'B'	Eastern (Southern)	2	60	Parsons	2	550	Foster Wheeler
Marchwood	Southern (Southern)	1	60	E.E.C.	1	550	John Thompson
Portishead 'B'	South-Western (Southern)	1	65	A.E.I.	3	300	Mitchell Engineering
South Denes	Eastern (Southern)	1	60	R.W.	1	550	Mitchell Engineering
Spondon 'H'	East Midlands (Midlands)	1	10	A.E.I.	1	180	Foster Wheeler
Willington 'A'	East Midlands (Midlands	1	100	E.E.C.	1	830	International Combustion
S. of Scotland							
Kincardine		1	120	Parsons	1	860	J. Brown
N. of Scotland	*County (and scheme)*						
Brodick (diesel)	Bute	1	0·6				
Cashlie (hydro)	Perthshire (Breadalbane)	1	11	English Electric			
Cuaich (hydro)	Perthshire (Tummel Valley)	1	2·5	Bruce Peebles (turbine: Gilbert, Gilkes and Gordon)			
Duchally (hydro)	Sutherland (Shin)	1	0·325	Gilbert, Gilkes and Gordon			
		1	0·125	Gilbert, Gilkes and Gordon			
Errochty (hydro)	Perth (Tummel Valley)	1	0·55	Gilbert, Gilkes and Gordon			
Lairg (hydro)	Sutherland (Shin)	1	3·5	Bruce Peebles (turbine: Boving)			
Lochay (hydro)	Perthshire (Breadalbane)	1	2	English Electric (turbine: Boving)			
Orrin (hydro)	Ross-shire (Conon Valley)	1	18	Bruce Peebles (turbine: Harland)			
Orrin (comp'n set)	Ross-shire (Conon Valley)	1	0·256	Armfield			
Shin (hydro)	Sutherland (Shin)	1	12	Bruce Peebles (turbine: Boving)			
Shin (Div'n Weir)	Sutherland (Shin)	1	0·1	Boving			

C. A. PARSONS & CO.

Progress in Manufacture—1959

IN a year which has not been noted for the number of new major turbo-generator orders placed, the most important one received by C. A. Parsons and Co. Ltd. was the 500 MW unit for the Colbert, Alabama, station of the Tennessee Valley Authority in the USA. This is a cross compound, double turbine unit driving two hydrogen and liquid cooled generators and operating with steam pressures of 2,400 lb/sq in. 1,050°F with reheating to 1,000°F. With this order there are also two 10,000 b.h.p. turbines for driving the boiler feed pumps at the same station.

A third 20 MW set has also been ordered for the Penal station of the Trinidad and Tobago Electricity Commission to join the two sets already installed there. The first of these was officially commissioned by the Governor of Trinidad and Tobago in February, 1958.

On transformers the company has received many orders for units from the CEGB including six 120 MVA 275/66 kV for the super-grid system, a further 210 MVA 16·5/295 kV generator transformer for West Thurrock station as well as 132 and 66 kV transformers up to 45 MVA.

Orders Completed

During the year a number of turbo-generators have been delivered and erected including the two 120 MW sets for Drakelow "B" and the second 120 MW set for Kincardine, the third 100 MW set at Ferrybridge "B," the first of six 100 MW sets for Aberthaw, all for the CEGB as well as units for Canada, Australia, India, South Africa, Jamaica and Nigeria. Canadian deliveries included the first 200 MW set for the Richard L. Hearn station of the Ontario HEPC which is now in service, the second set also having been completed during the year.

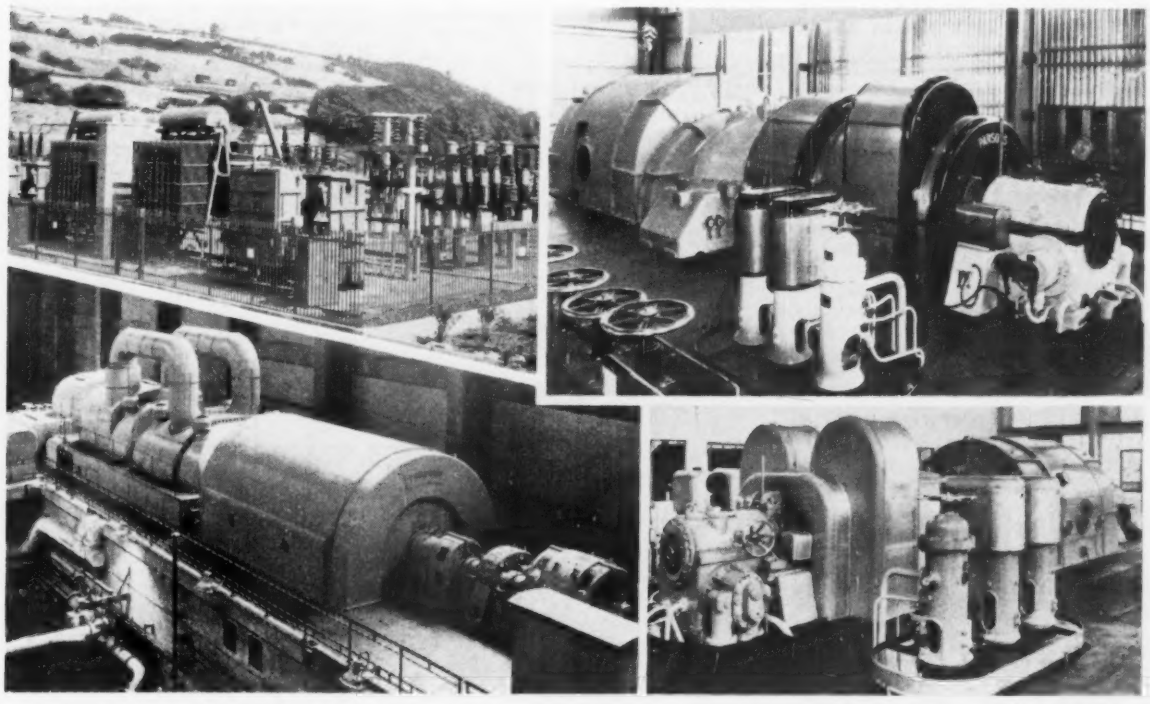
Australian deliveries include the second 60 MW set for Wangi (Lake Macquarie), 30 MW sets for Bulimba "B", Tennyson, Bunbury and Melbourne, and the first of two 15 MW sets for Musselbrook, NSW.

Generators for nuclear power stations in Britain which have been delivered during the year include the last of the eight 23 MW sets for Calder Hall and seven of the eight for Chapelcross. Four of the six 52 MW sets on order for Bradwell have also been completed and are now on site being erected.

In the Shops

Activity in the shops at Heaton has not slackened and some interesting sets are in course of design and construction in various stages. The third and fourth units for the Richard L. Hearn station are well advanced and will be delivered during the coming year. In addition, construction of the two 300 MW turbo-generators for Ontario HEPC and the 550 MW and two 200 MW sets for Thorpe Marsh (CEGB) is well forward.

In the transformer shops the 210 MVA 16·5/295 kV unit, the third for West Thurrock and the two 180 MVA 132/275 kV units for Keadby are to be seen in advanced stages of construction as well as the first of the seven 50 MVA 12·5/330 kV single phase generator transformers on order for the Snowy Mountains Hydro Electric Authority of Australia.



Top left, 15 MVA 3 phase transformers at Slaithwaite substation, YEB. Top right, 15 MW turbo-generator at Musselbrook, NSW, Australia. Bottom left, 120 MW turbo-generator at Drakelow "B" station of CEGB. Bottom right, 10 MW turbo-generator installed in the power house of the Shell Refining Co., Shellhaven, Essex

equipment for industry

Speed and frequency measurement

A PORTABLE, compact frequency meter with a wide operating range recently introduced, is designed for direct measurement of speeds either by signals obtained from an impulse generator, or from a photoelectric cell. The meter has eight ranges covering a frequency band of 10 c/s to 100 kc/s. Direct indication is given of either frequency or speed on a calibrated meter and provision is made on the instrument for connection of an external meter or recorder. The instrument is fully transistorised and includes a stable-frequency oscillator for calibration purposes. The input signal waveform is not critical and can have an amplitude varying from 75 mV to a maximum of 30 V. Accuracy is within ±5% of f.s.d., although on most ranges it is said to be better than ±1% of f.s.d. when calibrated with the internal oscillator. Power can be provided either from the mains or from a battery so that the instrument is suitable for use in isolated situations. It measures 13 in. by 9½ in. by 7½ in. and weighs approximately 21 lb. An optical probe incorporating a lamp and phototransistor for use with the instrument is also available and can be used for a frequency range of 5 c/s to 5 kc/s. It can be used in most ambient lighting conditions and measures about 4 in. square by 1¾ in. The instrument is manufactured by *Airmec Ltd., High Wycombe, Buckinghamshire.*

Insulating wire for 1,000° F

IN the aircraft and missile industries there is a continuing demand for smaller and lighter components which invariably means that electric equipment must operate at ever higher temperatures. In nuclear plants and many industrial applications there is also a demand for electrical equipment to withstand high temperature operation. For these and similar applications where normal insulation on copper wires would be inadequate, a flexible ceramic insulation has been introduced and named Ceramicite. This ceramic insulated wire has space factor comparable with enamel wire and can be used for winding magnet coils since it has a high degree of flexibility. It is claimed to be suitable for operating continuously at 1,000°F and to withstand 1,700°F for short periods. It has good electrical properties, an insulation strength of nearly 600 volt/mil at room temperature and insulation resistance at 1,000°F of 2 megohm/100 ft for a wall thickness of 0·35 mils. Although insulation resistance falls if exposed to a humid atmosphere, and it is not recommended for use under such conditions, development is proceeding on a waterproof coating. The Ceramicite coating is formed on a nickel-clad copper conductor and gives a coating claimed to have excellent abrasion resistant properties.

The same company are also manufacturing Tefbond, a bondable p.t.f.e. cable, and a range of two colour wires and cables in extruded p.t.f.e. Further details may be obtained from *Wandleside Cable Wks, Garratt Lane, S.W.18.*

Hand-lever control units

TWO oil-tight heavy-duty control units have recently been introduced offering a convenient alternative method of control to the conventional push-buttons for machine tools and other industrial applications. The first control unit is a four-position joystick controller which incorporates a locking device to prevent the joystick being inadvertently knocked into the wrong position. In use, a centre pin in the joystick is depressed, releasing the lock and allowing movement to one of four positions. In these positions, contact can be arranged to be either momentary or sustained. The construction allows the safety locking feature to be removed if required and also permits alteration from momentary to sustained contact operation and vice versa.

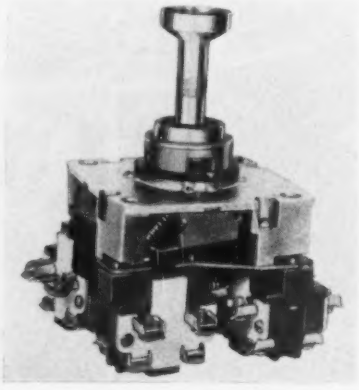
A second introduction with obvious applications for initiating emergency stops is a "wobble stick" suitable for mounting on a control desk or a pendant station. Merely knocking the lever in any direction will actuate the switch contacts. These two units are made by *Square D Ltd., Cheney Manor, Swindon, Wilts.*

Motors with integral brakes

IN many industrial processes, a driving motor is required which can be stopped quickly, either as part of the process or under emergency conditions. Recently announced is an increased range of 3-phase brake motor units from fractional h.p. up to 40 h.p. A single type of brake covers the requirements of the smaller motors, while for the larger sizes, two brakes are available, exerting a retarding torque either slightly greater than full load torque, or a torque of not less than 1½ times full load torque.

The brake is housed in the non-drive end bracket of the motor and is fitted to an extension on the motor shaft. The unit fails to safety, and there is provision to adjust the retarding torque exerted. The brake disc 1, runs on hub 2 keyed to the motor shaft 3, and is driven by the pins 4. The brake armature 5, slides on pins 6. A special four-pole magnet 9, opposes the thrust of the springs 7, whose pressure is adjusted by nuts 12. The brake can be slackened by a manual release screw 13, 14, 15. These brake motor units are manufactured by *Newman Industries Ltd., Yate, Bristol.*

The Airmec frequency meter is fully transistorised and has a range from 10 to 100 kc/s. It has an internal calibrating oscillator and can be either mains or battery operated



Joystick controller can select any of four positions by depressing a central locking pin and moving the lever

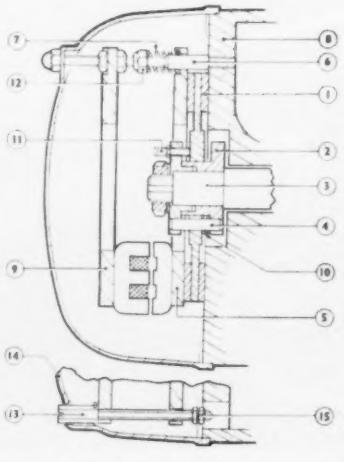


Diagram of the Newman brake unit mounted in a.c. motor non-drive end covers. It can be supplied with machines up to 40 h.p.

for the electrical trade

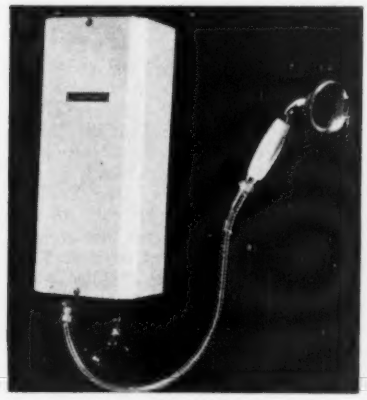
Instant hot water

THERE has always been a certain reluctance to accept instantaneous electric water heaters—the electrical equivalent to the gas geyser—on account of their high loading and poor load factor. At a time when electric cookers with top loadings of 10 kW and more are being installed in increasing numbers, objections to high loaded water heating appliances lose much of their force when it is realised that the diversity factor—the ratio of appliances on together at one time to the total installed—is lower than for cookers.

Even so, a water heater which will provide a 20 gall hot bath in about ten minutes would need to be loaded to 14-15 kW but there are many situations, both domestic and commercial, in which an "electric geyser" with an output of up to half a gallon per minute will meet all requirements.

Such an appliance is the "Plow" water heater, a neat unit for the domestic sink, the wash basin, the hairdresser or other user of hot water in small quantities, which measures 15 in. from top to bottom, is 6½ in. wide and only 4⅞ in. deep. The loading is 4 kW and the current is automatically turned on as the water flows and is cut-off when flow ceases. The temperature of the water is dependent on the opening of the stop tap, lower rates of flow producing hotter water. At maximum flow, 4 pints a minute, the temperature of the water will be around 100°F with cold water at 60°F and hot water is available within ten seconds of turning on.

The price of the appliance is £16 10s 6d including purchase tax and further details can be obtained from the makers *Plow Water Heaters Ltd., 6 Newport Rd, Cardiff.*



The "Plow" instant water heater with spray attachment for hairdressers. The standard outlet for domestic use is a 12-in. chrome-plated swan neck

Price down

AS a result of extensions to the company's polythene manufacturing plant at Wilton, Yorks, the price of "Alkathene" has been reduced from 2s 6½d to 2s 3½d per lb for the UK market as from 22 Dec. The last reduction of 2½d per lb was made in September, 1958, and the present price compares with 4s 3d per lb in 1951. The manufacturers of "Alkathene" are, of course, the *Imperial Chemical Industries Ltd., of Millbank, London, S.W.1.*

Price up

THE prices of the famous "Gripper" handlamps have had to be increased through rises in the costs of materials, overheads, etc., since the last change nearly six years ago. The standard handlamp is now 21s 8d, an increase of 1s 8d, and the "Wellglass" handlamp is up 2s 4d to 36s. The increases take place as from 1 Jan., 1960. Some spare parts have also been increased in price and details can be had from the makers *British Central Electrical Co. Ltd., 6/8 Rosebery Ave., E.C.1.*

Another baby 'fridge

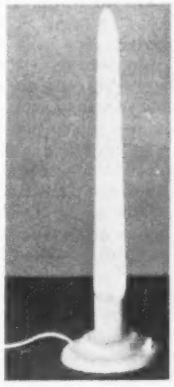
THE first newcomer to the domestic refrigerator market for 1960 is the 2·4 cu ft absorption type Main "Model 24." This will supersede the "Model 22" and is a cleanly designed unit in white or cream with red trims and light blue interior, 36 in. high by 21 in. square. Shelf area is now 5·4 cu ft and the absorption unit has been developed to make ice with an external ambient up to 95°F. The consumption on 210/230 or 230/250 volts a.c. or d.c. is 90 W. The price, including purchase tax and initial servicing, is £43 16s and the guarantee covers five years for the unit and one year for the cabinet and accessories.

Fuller particulars can be obtained from *R. and A. Main Ltd., (Electrical Division), 48 Grosvenor Gdns, London, S.W.1.*

The "Main Model 24" domestic refrigerator, a neat and efficient unit for the small flat or home, with 5·4 sq ft of shelf area, 2·4 cu ft capacity. Price £43 16s

Electric candlelight

A NOVEL and most attractive electric candle lamp for the bedroom or entrance hall is the new Mazda 60 W "Cand-lite," an excellent replica of a wax candle in its holder which gives a soft welcoming light without the attendant fire risks of wax candles. With clip on candle shades it would be a most attractive light for the intimate dining table. The price of the complete light and holder is 25s including purchase tax. The holder, or base, incorporating a switch and length of neat twin core plastic flex is cream.



The extremely attractive Mazda "Cand-lite", a safe replica of a wax candle with 60 W light for the period setting or intimate surrounding

The "candle" is a single ended tubular lamp rated at 60 W on a 1,000 hr basis and is replaceable, the price being 19s 2d inclusive of 2s 10d purchase tax. It is fitted with an edison-screw cap. This should prove to be a ready seller wherever it is displayed and it is, of course, made by the *AEI Lamp and Lighting Co. Ltd., of Melton Rd, Leicester.*

Low voltage fluorescent

FLUORESCENT lighting for the caravan, boat or car with only 12 or 24 V d.c. supplies is now possible with a new transistorised fitting incorporating a single 2 ft 20 W tube with or without "Perspex" diffuser, the "Eascolyte C.32." Current consumption is under 2 amp at 12 V or 1 amp at 24 V, but the light is about equal to a 60 W bulb. The weight is 5 lb with diffuser, 3½ lb without and the price for the control unit and batten is £8 18s plus 42s 6d for the diffuser. Tube, 14s 1d. Full details can be obtained from the makers, *Easco Electrical Ltd., 6/8 Brighton Terrace, Brixton S.W.9.*

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Grinding-in

THE trouble experienced by K.C. with "Bakelite" lampholders (17 Dec. issue) is the common lot of all householders and installation men responsible for safeguarding wiring installations. Lampholders are the last, and and apparently the weakest, link in the distribution chain from generating station to electric light.

The fault in all probability lies in B.S. 52,* which is the standard for lampholders, if it permits such shoddy accessories as are sold by chain stores to bear the number of the standard and thus appear to carry the hallmark of quality which its use implies.

At least one manufacturer has shown that there need not be appreciable difference between the coefficients of expansion of the inner brass lining and the plastic body of the lampholder. Until such improvements are generally available, compromises will be resorted to.

The retrograde step of using brass, instead of insulated lampholders is not a particularly happy solution, as normally these holders do not offer any facilities for earthing. Oil run between the threads will usually loosen the shade ring but it is a messy expedient and may easily ruin silk or parchment shades.—*M. D. E. Line.*

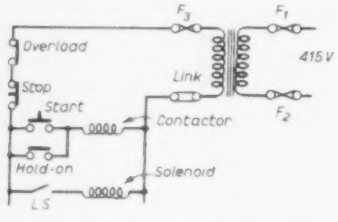
* *The BSI have only this week issued a supplement to B.S. 52 concerned with dimensional stability (particularly of shade rings), and quality of B.22 b.c. lampholders of moulded insulating material.*—ED.

Trouble in control

THE contribution under the above heading (3 Dec. issue) suggests the following comments. The immediate fact is that if the transformer had been properly fused, a fault would have been obvious and fault finding would have been made easier.

To cover correct fusing of the circuit, double-pole h.b.c. fuses are required in the 415 V supply lines. On the control circuit side, it is better to earth one side of the controls completely and use single pole fusing in the other side. With such an arrangement, switching would then be carried out in one pole only, namely, the live line.

With this arrangement, the control circuit becomes modified to that shown in the accompanying sketch. If the switching is carried out in the live pole only, then all faults to earth are cleared by the control circuit fuse F_3 without introducing spurious circuit operation as a result of the fault.—*K. J. Bladon.*

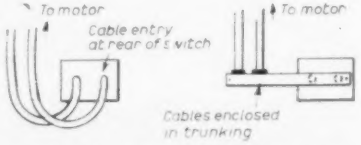


Modified control circuit for solenoids associated with automatic machine, indicating the use of fuses to give correct protection and to avoid spurious operation following a fault

Hot cables

A RIVET maker in a small factory reported that, on attempting to start the motor for his machine, the circuit-breaker tripped out. Mention was made of a slight flash observed at the back of the starting switch.

The motor, a 20 h.p. 3-phase squirrel cage machine, was controlled by means of star-delta switch, which was manually operated. The circuit between motor and switch consisted of two, three-core, armoured cables. At the cable entry to the switch, there was quite an appreciable dip and a wide sweep of the cables. With the handle of the switch in the "star" position a "Megger" insulation test was applied, which indicated a zero reading, and examination showed that the armouring of the cable had fused at the entry of the switch.



Schematic view (left), of original cable arrangement at rear of star-delta switch in which heat from plates just below cables eventually damaged insulation to the point of breakdown. Right, shows later arrangement with cables from switch enclosed in trunking before being taken vertically to motor

It was noted that directly below the cable entry, a steel bracket was fixed adjacent to the machine. The rivet maker explained that the bracket supported hot plates to anneal for shearing.

To clear the fault, the armouring was peeled off. Evidence showed that, after a long period, the insulation had become baked, due to the heat from the hot plates and, as the armouring was disturbed, the brittle insulation crumbled. It was obvious that, in view of the heat rising from the hot plates, the cable entry would have to be raised to a higher level. Meanwhile, the cables were tied up out of the way, and the motor started up temporarily.

Later, it was decided to enclose the cables, six in number, by employing a short length of 4 in. square trunking. The necessary holes were drilled, two for the bonding clamps of the armoured cables, and two for the cable entry at the switch. Tapped holes at the back of the switch enabled the trunking to be bolted horizontally, as shown.—"*Novis.*"

* * *

As its readers will have long since realised, "Problems and Practice" covers in its way, the whole field of electrical engineering, although the aspects dealt with most frequently are, not surprisingly, industrial and domestic installations. Normally, stories told by its contributors, have no significant topical interest, but this time of year merits something in lighter vein and it is in this spirit that the following story from our postbag is offered. Like all good stories, moreover, it has a moral.—ED.

Sparkling lamps

VARIOUS ideas on test lamps have been put forward recently in this feature and readers may be interested in what I use. Most of the instruments described are complicated but my test lamp is simple and effective, being merely a brass lampholder and lamp with two "short ends" of wire connected to it. On 240 V the lamp lights up and on 415 V it explodes.

On one occasion when testing to earth on three phase, 400 V busbars, the "short ends" shorted out where they enter the brass lampholder, due to the insulation being chafed at this point. This caused a flashover which brought the main breaker out. The flashover caused a stoppage which cost my firm about £500 and cost me my raincoat which had a hole burnt in it as I had hung it on the side of the busbar chamber. The management did not recompense me for my raincoat.

Strangely enough, I did not get a shock from this episode as I had taken the precaution of standing on a rubber mat. I observe that the insulation of the "short ends" is wearing thin again and I really must replace the wires when I can get around to it.—*M.E.N.Acc.*

News of the Week

NEW LEGISLATION TO CHECK UNFAIR TRADING PRACTICES URGED

Citizens' Advice Bureau on Consumer Protection

UNFAIR trading practices, with emphasis on the activities of door-to-door salesmen and hire purchase transactions, are reported to the Board of Trade Committee on Consumer Protection by the National Citizens' Advice Bureau Committee in a long memorandum of evidence compiled from returns by Citizens' Advice Bureaux throughout the country.

During 1958 the bureaux dealt with 23,190 inquiries relating to trading, including complaints about h.p. problems, unsatisfactory goods and services, and methods of obtaining redress. The CAB committee recommends that a single unbiased "higher authority," able to take legal action on behalf of the consumer, should be set up to consider complaints after unsuccessful approaches to dealers and manufacturers.

The committee also recommends that legislation governing the sale of goods should be brought up to date, so that a manufacturer or retailer should not be able, by means of a private contract, to deprive customers of protection afforded by legislation. There were many complaints of "bait advertising" and "switch selling." Hire purchase regulations should be revised, the report urges, to raise the financial limits under which consumer protection is afforded.

The report implies that the law controlling door-to-door trading is inadequate, and proposes that licensing of these salesmen should be used in such a way that authorisation could be denied to those whose techniques were not founded on good business ethics.

Guarantees on products come in for criticism, particularly where in a particular article different periods of guarantee are laid down for different components. In one example quoted, a well-known make of refrigerator was advertised as having a "cooling unit guaranteed for five years," but after the appliance had been purchased, the customer found that the heater and thermostat were guaranteed for one year only, while the remaining parts of the cooling unit were covered by the five-year period.

Also it has been found that a guarantee to replace a component meant that the firm would supply a 2s part free of charge, but the cost of time and labour involved in replacing it, some £2 or £3, had to be paid by the customer.

The committee recommends that standards of safety for electrical equipment should also be made legally enforceable, particularly in the case of imported goods where manufacturers are outside the field of existing consumer protection machinery in this country. It is suggested that a guarantee of safety should accompany any article which is potentially dangerous.

Manufacturers and retailers are urged to make wider use of informative labelling. There should be greater regulation of the terms and conditions implying test, guarantee or approval, and if later production runs fall below the original standard, the approval or test marks should be withdrawn.

Solidal Cables in Production

A NUMBER of cable manufacturers are starting production of solid core aluminium cables (described in our issue of 4 June, page 868), developed by the Northern Aluminium Co. Ltd. and the Aluminium Laboratories of Banbury, who were prepared to supply the conductor cores to interested manufacturers.

Companies now producing "Solidal" cables (the name registered for the design) include: Aberdare Cables Ltd., AEI Cable Division, Crompton Parkinson Ltd., Enfield Standard Cables Ltd., W. T. Glover and Co. Ltd., Hackbridge Cable Co. Ltd., Pirelli General Cable Works Ltd., Sterling Cable Co. Ltd., and Wandleside Cable Works Ltd.

M.-R. REORGANISE

AS foreshadowed by Mr F. P. Bishop, chairman of Morphy-Richards Ltd., in the company's annual report, two new wholly owned subsidiaries have been formed as part of an internal reorganisation to secure improved operating efficiency. The companies are Morphy-Richards (Cray) Ltd. and Morphy-Richards (Sales and Service) Ltd. Mr Bishop intimated that one of the companies will take over production at St. Mary Cray, Kent, while the other will provide certain central services for the M-R group, presumably concerning itself with distribution.

G.E.C. form five new groups

TO reorganise their General Products Group, GEC have formed five new groups, each dealing with a specific category of equipment, and each controlled by a group managing director responsible for overall planning and direction, including design, development, production, sales and distribution. The groups and appointments (effective as from 1 January) are:

Domestic Equipment Group, incorporating the present Domestic Equipment Division (Mr E. A. Fowler).

Installation Equipment Group, incorporating the present Installation Equipment Division and Pirelli-General Cable Division (Mr R. H. Phillips).

Lighting and Heating Group, incorporating the present Lighting Division and Industrial Heating Department (Mr D. L. Tabraham).

Osram Group, incorporating the present Osram Lamp Division and all glass and lamp component units (Mr A. E. Page).

Radio Group, incorporating the present Radio Division (Mr M. M. Macqueen).

Further details of these appointments appear on page 19.

U.K. SIGNS OUTER SEVEN TRADE PACT

THE convention establishing the "Outer Seven" European Free Trade Association between Britain, Sweden, Norway, Denmark, Portugal, Austria and Switzerland was signed last week by Mr Heathcoat Amory, the Chancellor, and Mr Maudling, the President of the Board of Trade. The pact, which means the removal over the next 10 years of trade barriers between the seven countries concerned, was initialled on 20 November by Ministers of the member countries. It is now subject to ratification, which must be completed before 1 July, 1960, when the convention is due to come into operation.

A Decade of Appliance Progress

OVER the ten years 1948-58 consumer spending on electrical, radio and other durable goods, although only 2% of total expenditure, rose by 120% as compared with 22% for consumer purchases of all kinds. This is revealed in a survey of the past decade published last week in a Treasury bulletin.

Particularly striking is the growth in spin and tumbler dryers, which were virtually a new product in 1956. During the second half of that year deliveries of "other domestic laundry equipment," of which dryers make up the bulk, were running at only £100,000 a year. In 1957 the figure rose to £1·2 million, in 1958 to £3·8 million, and in the first half of 1959 the annual rate reached £7·3 million.

Washing machine sales doubled over the period 1953-55, then declined, but picked up sharply in the autumn of 1958 with the easing of credit restrictions. Output in the first half of 1959 was 50% up on a year earlier.

Refrigerators followed the same pattern, output being nearly double for the same six months. Electric cookers and vacuum cleaners also enjoyed a brisk rise in demand as compared with the previous year.

The survey suggests that in 1957 the "density" of many appliances in relation to population was lower in the UK than in certain Continental countries, and much lower than in the US. In that year the US had eight times as many refrigerators as the UK proportionately to population, and more than twice as many washing machines.

Denmark, Belgium, Norway, Netherlands and Sweden all had a greater washing machine density than the UK. The Swedish figure for refrigerators, five times our own, was the highest in Europe.

Ownership

An analysis of ownership of consumer goods in various countries throughout the world during the period 1955-57, published recently in *Economic Review*, gave the following figures for refrigerators and washing machines.

Ownership per 1,000 population, 1955-57

Country	Refrigerators	Washing Machines
U.K.	37	97
Sweden	187	119
Belgium	53	151
W. Germany ...	39	45
Denmark	50	40
Canada	178	173
Australia	197	104
N. Zealand ...	132	144
U.S.A.	265	235

Production

Britain's biggest European competitor in appliance manufacture is Western Germany. The following table, derived from a survey published a few weeks ago by BEAMA, shows output of certain electrical products per thousand head of population in the UK and W. Germany during 1958.

Output per 1,000 population, 1958

	U.K.	W. Germany
Population ...	52m	72m
Washing Machines	17	10
Electric Cookers ...	7	10
Vacuum Cleaners ...	27	20
Space Heaters ...	33	22
Electric Irons ...	48	57
Elec. Blankets ...	13	15

It seems likely that the 1959 figures, when available, will indicate the UK's strengthening position in the production and consumer purchasing of electrical appliances.

RELAY FIRM TURNS TO APPLIANCES

TELEFUSION LTD., the radio relay and TV rental concern, is to extend into the domestic appliance retail market, for which a special division has been formed. The company has branches in over 60 towns, with nearly a dozen shops in London.

Hoover Expansion

WITH the acquisition of the lease of a 68,000 sq ft factory at Merthyr Tydfil from Wales and Monmouthshire Industrial Estates (acting for the Board of Trade), Hoover are about to establish what is claimed to be the largest single group of washing machine factories in the world.

The new factory, with existing factories in the area and an extension now being built, will bring the total space occupied in South Wales by Hoover washing machine enterprises to some 800,000 sq ft, increasing local employment by well over 1,000 people.

Mersey Cable Contract

AN order for 30,000 yd of multi-core cable for the new Mersey Mill extension of the Bowater Paper Corporation Ltd. has been completed by Mersey Cable Works Ltd. Installation was carried out by Tanjon (NC) Ltd. The wiring for the mill's grinder house control and indication circuits consists entirely of this p.v.c. armoured multi-core control cable, which is also used on one of the newsprint machines.

ENFIELD-STANDARD CABLES OPERATING

OPERATIONS of the newly-formed company, Enfield-Standard Power Cables Ltd., with a capital of £1 million, commenced on 1 January. The position of chairman of the new company is filled at alternate meetings by Mr F. C. Wright, managing director of Standard Telephones and Cables Ltd., and Mr J. Grimston, managing director of Enfield Rolling Mills Ltd.

The other directors are: Mr T. R. Scott (managing director, Standard Telephones Communication Laboratories), Mr B. Powell (secretary, Enfield Rolling Mills Ltd., Mr H. W. Parker (controller, Standard Telephones and Cables Ltd.), Mr J. E. Sunderland (formerly managing director, Enfield Cables), Mr H. J. D. Shrimpton (STC cable group manager), Mr E. C. Lee, Mr G. H. Bairstow and Mr M. J. Smith. Mr Lee is general manager, Mr Bairstow, general works manager, and Mr Smith, commercial and technical manager.

Registered office of the company is Connaught Hse, Aldwych, W.C.2. It has been formed by the amalgamation of the power cables side of the businesses of Enfield Cables Ltd. (a subsidiary of Enfield Rolling Mills Ltd.) and of Standard Telephones and Cables Ltd. to which we referred on 12 Nov.

In the first large installation of its kind in the country, 8 ft Luveline fittings mounted in continuous rows illuminate the ground floor of the Chesterfield Co-operative Society's new store. Two injection moulded polystyrene louvred diffusers are used on each 8 ft fitting, which can be hinged down for cleaning or relamping

Westool enter Domestic Market

ENTERING the domestic market for the first time, Westool Ltd., of St. Helen's Auckland, manufacturers of electrical and control equipment, have started production of the Cotswold fan heater on a newly installed assembly line at their Durham factory. The manufacturing rights have been acquired from New Day Electric Ltd., now in voluntary liquidation.

The Cotswold fan heater provides switched variable heating of one or two kilowatts and can be used on the floor or mounted on a wall by a bracket (supplied free). Price £7 7s 4d tax paid.

Picture shows part of the new assembly line installed at the St. Helen's Auckland works of Westool Ltd., for the production of the Cotswold fan heater. In acquiring the manufacturing rights from New Day Electric Ltd., Westool are entering the domestic market for the first time

OFFICIAL PUBLICATIONS

Electrical Accidents and Their Causes, 1958. HMSO. 5s (see page 9).

BS 52. Supplement No. 1. B.C. Lampholders of Moulded Insulating Material. 5s.

BS 448. Electronic-valve Bases, Caps and Holders. Sections B5G/5, and B7E/F. 2s each.

BS 1862. Cables for Vehicles. 7s 6d.

BS 3180. Thermostats for use with Domestic Electric Cookers (a.c.). 4s 6d.

NUCLEAR POWER GROUP FORMED

WITH the formation of an industrial consortium named The Nuclear Power Group, negotiations announced last August between the Nuclear Power Plant Co. Ltd. and the AEI-John Thompson Nuclear Energy Co. Ltd., with a view to arranging collaboration between the two companies on nuclear projects, have now been completed.

As from 1 Jan., 1960, the companies are operating as equal partners, with a head office at Radbroke Hall, Knutsford, Cheshire. Constituent members of the NPG are: Associated Electrical Industries Ltd.; Clarke Chapman & Co. Ltd.; Alex Findlay & Co. Ltd.; Head, Wrightson & Co. Ltd.; Sir Robert McAlpine & Sons Ltd.; C. A. Parsons & Co. Ltd.; A. Reyrolle & Co. Ltd.; Strachan & Henshaw Ltd.; John Thompson Ltd.; and Whessoe Ltd.

Each partner company has three representatives on the board. The first board consists of the following: Viscount Chandos (chairman), Sir Edward Thompson and H. West, representing AEI; R. Edwin McAlpine (vice-chairman), H. H. Mullens and Sir John G. Wrightson, Bt., representing NPPC; and A. J. Sayers (general manager). Senior executives of the group are: S. A. Ghalib (deputy general manager), W. A. K. Wicks (secretary), R. D. Vaughan (chief engineer) and J. R. M. Southwood (deputy chief engineer).

Objects of the NPG are primarily: to assist partner companies to complete Berkeley, Bradwell and Latina nuclear power stations; to design, develop and sell nuclear reactors of all kinds, and construct nuclear power stations at home and abroad, also nuclear units for ship propulsion; to supply related components and materials; and to conduct research and development in nuclear matters.

The NPPC have running contracts for the design and construction of nuclear power stations at Bradwell, Essex (300 MW) and Latina, Italy (200 MW). AEI-JT are engaged on the nuclear power station at Berkeley, Glos (275 MW).

B.E.A.M.A. to discuss Appliance Exports

BRITAIN'S exports of domestic appliances is to be the theme of a one-day export sales conference organised by the Export Committee of the BEAMA Domestic Appliances Division. The President of the Board of Trade, the Rt Hon Reginald Maudling, M.P., will speak at the conference, which will be held on 10 February at the Connaught Rooms, W.C.2. Other speakers include Sir Leslie Gamage (president of BEAMA and chairman GEC) and Viscount Chandos (chairman AEI).

Although primarily intended for BEAMA members, the organisers have decided to invite all manufacturers of domestic electrical appliances and equipment to attend. The conference is designed to appeal equally to managing directors, export managers and executives, as well as to others not directly involved in export work, such as design and technical personnel. Speakers will concern themselves with the practical problems involved in seeking to increase exports.

Registration fee is 3 gn per person, including refreshments and luncheon, plus programme and full report of the conference proceedings. Applications for registration should be sent to BEAMA, 36 Kingsway, W.C.2, not later than 10 Jan.

LECTURES ON ENGINEERING

A PROGRAMME of special lectures on engineering subjects to begin in January has been arranged by the Department of Engineering of Hendon Technical College, London, under the auspices of Middlesex County Council Education Committee. Details are given below. The lectures, arranged in series of ten, are generally suitable for students holding the HNC, or university graduates.

Subject	Lecturer	Starting	Time
Mechanical Vibrations ...	H. A. Sparling, B.Sc.(Eng.), A.M.I.Mech.E.	Jan. 11	7-9 p.m.
Control Engineering for Production Engineers	J. J. Oliver, A.M.I.Mech.E., A.B.I.M. (and industry experts)	Jan. 25	4-6.30 p.m.
Electronic Measurements	J. N. Browne, B.Sc.(Eng.), A.M.I.E.E.	Jan. 26	7-9 p.m.
Statistics	A. T. F. Nice, M.A.	Jan. 25	7-9 p.m.

Fee for all courses is £1, payable at the first lecture of the course. Full details are available from the Head of Engineering Dept., Hendon Technical College, The Burroughs, Hendon, N.W.4.

E.M.I. IN CANADA

RADIO and television broadcast equipment manufactured by EMI Electronics Ltd. is to be distributed and serviced in Canada by Canadian General Electric to supplement its existing line of equipment under an agreement signed last week by the two companies. The equipment has been specially designed by EMI to meet North American standards.

Review of B.S.I. - C.S.A. Activities

IT is now nearly ten years since the formation of the joint approvals agency by the BSI and the Canadian Standards Association. At a recent meeting of the UK Advisory Committee, under the chairmanship of Mr. D. Maxwell Buist, export director of BEAMA, the work of the agency was reviewed. The secretary, Mr J. P. Roberts, reporting progress over the past 12 months, said that the rate of application for approval had increased steadily and the number of approvals now stood at 220. With an increase in trained inspecting staff, it was now possible to visit a manufacturer who was seeking approval for his products within 14 days.

Manufacturers had apparently now accepted the fact that there was no alternative to obtaining approval prior to exporting electrical goods to Canada, notwithstanding the expense involved in getting their products approved, and complaints were now very few.

With the removal of the Approval Agency's staff to the BSI Testing Centre at Hemel Hempstead in June last, much of the difficulty and criticism concerning the agency's testing methods and facilities had been removed, since the flexible generating equipment which had been installed there enabled the products submitted to be examined under conditions operating in Canada.

It was hoped that the overall cost to the manufacturer in obtaining approval would decrease as a result of this move. Dr W. P. Dobson, chairman of the CSA board and Mr Gordon Tebb, manager of the CSA's Toronto Laboratories had visited Hemel Hempstead and were well satisfied with the new arrangement.

At the end of the meeting the chairman explained that, as he had resigned his appointment as export director of BEAMA recently, he thought it inappropriate for him to continue to hold the chair. After warm tributes had been paid to his work on behalf of British and Canadian trade relations, which dated back even beyond the creation of the agency, Mr W. L. Sims, assistant managing director of Wadkin Ltd., the machine tool makers, was unanimously elected as the new chairman of the committee.

Industrial Lighting Conference

A CONFERENCE on Industrial Lighting, organised by the British Lighting Council, is to be held at Brettenham Hse, 16-18 Lancaster Pl, W.C.2, on 20 Jan., commencing 9.30 a.m.

Lectures include: *Good Lighting and Its Justification*, by A. Wilcock, A.M.I.E.E., DIP.M.I.E.S.; *Lamps and Related Equipment*, by A. D. S. Atkinson, A.M.I.E.E.; *Lighting for Special Processes*, by A. Wilcock; and *Maintenance and Economics*, by W. Robinson, B.SC. In addition, a film produced by EDA, entitled *New Light on Industry*, will be shown.

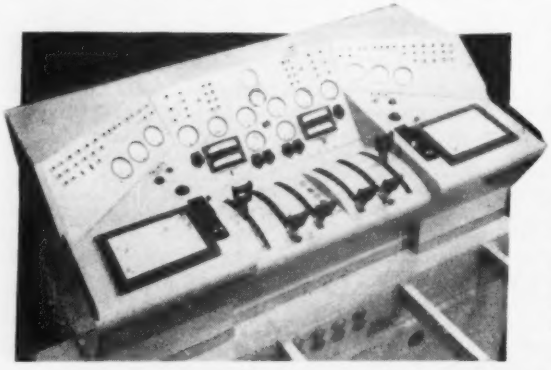
Registration fee for the conference is 10s 6d, which includes refreshments and literature. Applications should be sent to G. B. Durham, London Regional Engineer, at the BLC offices not later than 12 Jan.

Maudling to open Earls Court Show

THE President of the Board of Trade, the Rt Hon Reginald Maudling, M.P., will open the ninth National Electrical Engineers' Exhibition at Earls Court (5-9 April) at noon on 5 April.

This year a Marine Electrics feature will display electrical and electronic equipment from the aircraft carriers, HMS *Victorious* and HMS *Hermes*. A prominent exhibit will be control equipment as used in the s.s. *Canberra*, the largest liner to be built in Britain since the war. Weighing 45,000 tons, and powered entirely by a.c., the *Canberra* is due to be launched around the time of the exhibition.

Other features include: an electrically heated carpet (claimed to be the world's largest) covering 1,000 sq ft with 11 kW loading (Thermalay); outdoor electrical equipment including a 5,000 sq ft display of heavy transformers (English Electric and others); an electrolier suspended from the roof, measuring 75 ft in circumference, with 18½ kW loading (W. McGeoch & Co.); and one of the latest 85-ton electric locomotives built by Metropolitan-Vickers for shipment to South Africa.



Ready for installation in the new P & O liner "Canberra" is this control console for the 85,000 s.h.p., 147 r.p.m. propulsion machinery being built by AEI Heavy Plant Division. The console has direction, speed and starting levers; full machinery instrumentation; running and alarm lamps; and excitation switchgear for alternator and motor fields

Sir Leslie Gamage Looks Ahead

THE year 1960 will be a crucial one for the electrical industry. This was the view expressed by Sir Leslie Gamage, chairman of GEC, in a New Year's day forecast of prospects in 1960.

Pointing out that for the electrical companies 1959 was a good year "although cut-price competition in lamps, electric meters and cables has, to some extent, eaten into our profits," Sir Leslie prophesied that at home, in the coming year, the market for consumer goods would be unlikely to expand a great deal.

"As a result there will be much keener competition for the consumer's pound. On the heavy engineering side the immediate prospects are good, but the long term outlook is still uncertain."

In the export field, Sir Leslie thought that the Outer Seven link would benefit the British electrical industry, but Common Market prospects were not so good, unless we could find ways of competing with the electrical industries of the "Six" on more equal terms.

"In the years to come we must redouble our efforts to sell British knowledge and ideas where we can no longer sell equipment alone." Sir Leslie added. "I have in mind such transactions as the 'know-how' agreement on nuclear propulsion between the GEC and MAN of Germany, or the recent sale of 'know-how' and equipment for the manufacture of chemicals by a British consortium to the Russians."

Nevertheless, Sir Leslie looked forward with confidence to the year ahead, given a slowly expanding home demand without inflation, plus a relaxation of import restrictions by primary goods producing countries who were now in a better position to buy.

ELECTRIFYING INCREASE IN RAIL TRAVEL

SINCE the new electrified rail services in Kent started operating last June, more than three million tickets have been sold, an increase of nearly a third on the same period of 1958, British Railways Southern Region reports. Stations in the area coping with a 40% increase in passengers have taken an extra £50,000.

That the fine summer was not wholly responsible is shown by November ticket sales, which were also 30% up on the same month last year.

Fatigue of Welded Structures

A SYMPOSIUM on Fatigue of Welded Structures, organised jointly by the British Welding Research Association and the Engineering Department of Cambridge University, is to be held from 29 March to 1 April, 1960, in Cambridge University's Engineering Department.

Several papers will be presented by experts, including contributions from the USA and East Germany, dealing primarily with structures fabricated by fusion welding processes. Fee for membership is 15 gn. Full details are available from the British Welding Research Assn., Abington Hall, Abington, Cambs.

£37,000 A-POWER SURVEY

DURING 1958-59 sums totalling £37,074 were spent by the Government on surveys for the proposed nuclear power station in Northern Ireland. Of this amount £17,520 was paid for consultant fees and expenses, while £18,863 was used for investigating the suitability of various sites.

Under the existing arrangement payments to consultants and contractors were made by the N. Ireland Electricity Board, who would become the designated undertakers of the scheme, the amount involved being recouped from the Government.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, January 5

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	255	−7½
,, (3 months)	242	−3
LEAD, refined pig, 99·97% purity (cash)	75½	−½
,, (3 months)	74½	−½
TIN, refined, min. 99·75% purity (settlement)	791	+5
(3 months)	786	+3½
ALUMINIUM, ingots 99-99·5%	186	—
,, wire bars 99% purity	209	—
BRASS Strip 63/37	220½	−3
SILVER (Troy oz)	80¼d	—
ZINC, virgin, min. 98% purity (cash)	95½	−¾
,, (3 months)	90¾	+¼
RUBBER, per lb.		
No. 1, R.S.S. spot	34½d	+⅛d
c.i.f. basis, ports, Mar.	33½d	+⅛d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	66½	—
Mild Steel Tape (0·04 × 1½ in.)	47/14s	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	71½	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	35c	+2c
Lead (New York)	12c	—

Do clothes tangle or dangle?

WHAT happens to clothes in washing machines is rapidly assuming the proportions of a major controversy as leading manufacturers intensify their advertising. Hoover, protagonists of the pulsator mechanical action, are currently promoting their products in the Press and on TV in a series of advertisements, which began in November, condemning the "wishy washy" action of machines using the paddle agitator principle. This, they claim, just "dangles" the clothes in "practically motionless" soapy water.

Hotpoint, on the other hand, have for two years asserted in extensive Press and TV advertising that their washing machines, of the agitator type, do not "tangle" clothes as do machines using a different mechanical principle, and therefore wash cleaner. This argument they claim to have substantiated by laboratory tests which have included the use of radioactive tracers and a Geiger counter.

Whether the clothes tangle or dangle, highly competitive appliance advertising is the more likely to stimulate consumer interest, said a spokesman of one well-known manufacturer. It may give the trader a talking point with which to clinch many a sale.

On the other hand, it may also give the prospective customer a talking point to put the trader in a difficult position as he is forced to explain (or explain away) the conflicting claims of rival manufacturers.

Who foots the Conversion Bill?

THE question of who should pay the cost of converting electrical equipment and appliances when a family moves from a house in a sub-standard area to one having a standardised supply is to be raised with LEB by a Camberwell County Council deputation. The case concerns a family moving from a 210 V area to a 230 V who were required to pay £21 for conversion of apparatus.

General policy of the board is to pay for conversions involved in standardisation schemes, but not where families move from a sub-standard area to a standard. The Council consider this procedure to be unfair. "It may be justified in cases where the vacated house is about to be given standard electricity," said a Council spokesman, "but we feel that where the vacated house is to be demolished, the pledge to pay for conversion of equipment should be transferred with the outgoing tenant. The principle involved is an important one owing to the vast amount of slum clearance which is going on."

TV Sales Puzzle

SALES of radio sets by RTRA members declined in November, while TV sets showed only a seasonal increase, actual sales being less than in November, 1958. In view of this unseasonal trend, the RTRA say that it is impossible to predict what the December figures will reveal.

This new Aerialite branch, with 16,000 sq ft of floor space, at 11-12 Paddington Green, W.2., was rebuilt from what was formerly the Paddington Men's Club, and a new block of offices with warehouses and lifts to the second floor has been erected. New showrooms, a trade counter and stores with road loading facilities have been completed. The Aerialite system of floor-warming is used in some of the offices to enable customers to judge this type of heating. Stocks include flexibles, cables, appliances, aerials and accessories

Sayings OF THE WEEK

"In some places there was sufficient space under a [substation] *gate to admit a grown man."* . . . From *Electrical Accidents and their Causes, 1958.*

"Keeping doors closed of upper-floor rooms often makes a great difference to the warmth of the ground-floor rooms." . . . A. E. JEPSON, writing to the *Financial Times* on the cost of heating a house.

"In the years to come we must redouble our efforts to sell British knowledge and ideas where we can no longer sell equipment alone." . . . SIR LESLIE GAMAGE, in New Year forecast.

News in Brief

A new company, James Booth Aluminium Ltd. has been formed to acquire the wrought aluminium and aluminium products business of James Booth and Co.

Work may resume on 11 Jan. on the Motherwell Bridge and Engineering Co.'s contract at Hunterston nuclear power station. A memorandum of agreement is being prepared for signature by representatives of the unions involved and the company.

Annual luncheon of British Refrigeration Association is to be held at Connaught Rooms on 25 March. The President of the Board of Trade, Mr R. Maudling, has accepted an invitation to attend.

Annual general meeting of the EIBA, Manchester and District branch will be held on 26 Jan., at 5.30 p.m. at the Engineers' Club, Albert Sq.

Basildon new town, Essex, is to have a bridge with an electrically warmed surface carrying a new road over a railway line. The EEB will install the cables.

The Domestic Refrigeration Development Committee are to show the Press all current refrigerator models made by their ten member firms in a special exhibition on 25 Feb., at the Cafe Royal.

Company Activities

1960! And Leap Year! All the signs at present point to yet another prosperous Stock Exchange 12 months, but even so it is doubtful if we shall be quite so good as never-to-be-forgotten 1959 during which the *Financial Times* index of industrial ordinary shares soared no less than 50% from 225·4 to 338·4.

1960 will be the year in which the majority of economic forecasters are confidently expecting the nation's heavier industry to change up from low to higher gear. Steel production, now at around 95% of capacity, and the recent revival in machine tool orders, are strong straws in the wind. Industrial re-equipment and re-expansion will necessarily mean a resurgence in demand for heavy electrical goods and investment in such shares as Associated Electrical Industries at 64s, in General Electric Co., at 46s 3d and English Electric at 52s 9d will have proved worth-while ventures come this time, 1961.

AEI will be reporting early in the New Year—around March—on trading experience for the year ending 31 Dec. 1959. It would be, perhaps, a trifle premature to expect the recent regrouping to have had any marked effect on the figures although over the longer term the effect will be to eliminate the previous competition between the many constituent companies of the group, leading, it is hoped, to some increase in efficiency. Back in April, chairman, Lord Chandos, reported at the shareholders' meeting that profits for 1958 did not increase in step with increases in output and that conditions generally in the electrical industry were not particularly favourable although the market for domestic appliances was buoyant and demand for television tubes and radio valves after an unpromising start showed much more promise by the end of the year. These latter observations, of course, might now be appropriately applied to their heavier products while it is common knowledge that consumer electrical durables have this year experienced their biggest-ever boom. It accounts for the firmness of AEI's £1 ordinary shares now standing at around 64s to yield 4·6% on the 15% dividend 1·5 times covered by earnings. Even so, the shares are currently 3s below their 1959 "high".

Sir Leslie Gamage's General Electric Co. came out last week with its "follow-my-leader" announcement on re-organisation. Its General Products Group has been re-organised and five new Groups have been formed, each to be under the control of a Group Managing Director. Full details are given elsewhere in this issue. For some time now the City has looked hopefully for a re-invigoration of GEC's top management and so greeted the news with a 1s rise to 46s.

Those seeking income will also welcome the Decca Record intention to issue £4,500,000 6% unsecured loan stock which is to be used to reduce bank overdrafts of almost £2,360,000 and to provide further working capital. A good response is expected.—*From our City Correspondent.*

Frederick Braby and Co. Ltd.

Trading profit for the year to 30 Sept. last dropped to £57,320 from the previous year's total of £353,321. Indeed, after allowing all charges there is a net loss of £172,576 for the year, compared with a previous profit of £69,544. But the dividend is maintained at 5%.

Brook Motors Ltd.

There is an upward trend in demand and every prospect that this will continue, Mr F. V. Brook, the chairman, reports. In the year ended 30 Sept. last Canada exceeded expectations in its first year of operation, but other overseas markets showed varying conditions, although there was a general improvement in direct export sales. The improvement in recent months may be due in no small measure to the better international atmosphere, in the chairman's opinion. An extension to the f.h.p. motor factory, now completed, will contribute towards increased production and reduced manufacturing costs. Although the present demand is exceedingly good, Mr Brook warns that since the abandonment of price agreements with the introduction of the RPA Act, there is a general move by many companies to obtain a larger share of the available demand by reducing prices, and competition will be keen. Concerning the proposed one-for-six scrip issue, it is emphasised that the capitalisation of reserves will not influence the board in deciding upon the amount of profit to be distributed by way of dividend in the future.

Colvern Ltd.

In announcing an unchanged interim dividend of 10%, the directors state that the encouraging progress earlier reported continues, and both turnover and profit margins for the first eight months of the current year are at a higher level than that for the corresponding period of 1958-59. With order books in a most satisfactory condition, the directors feel that unless unforeseen circumstances arise during the remaining months, the final result will give them an opportunity to recommend an increase in the final dividend rate of 17½% paid for 1958-59.

Courtney Pope and Co.

In order to cope with expansion of the electrical company, which made the greater contribution to the group's results, a new building is contemplated for completion early in 1961, Mr L. R. Courtney, the chairman, reports. This will involve heavy capital expenditure, but outgoings during the current year can be met from resources, he adds. The directors are considering the formation of a holding company.

F. McNeill and Co. Ltd.

The board of directors of this concern (which controls the General Cable Manufacturing Co. and Brittanic Cables Ltd.) have issued a warning concerning some optimistic reports in the lay Press recently. While not wishing to suggest that earnings will not cover the dividends paid in the past, the directors point out that a substantial part of past profits have accrued from their interest in their cable subsidiaries. But the cable industry is suffering from price competition, and they feel that profits of the McNeill group are bound to be affected.

Solartron Electronic Group

Consolidated trading profit of this group (in which Firth Cleveland are acquiring a 53% interest) is £130,823 for the year ended 4 July last. Total for the previous year was £163,628. After taxation, etc., the net profit is £4,840 (*£31,387*).

Yorkshire Copper Works

Concerning our reference to this company on 24 Dec. we are asked to make it clear that Yorkshire Imperial Metals Ltd. is jointly owned by Yorkshire Copper Works (Holdings) Ltd. and ICI.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

7 Jan.—Ashington U.D.C. Electrical installations in 64 flats at Sixth Ave.—See 31 Dec. issue.

7 Jan.—Cardiff T.C. Provision of six-person passenger lifts, on fixed-price basis, at Gabalfa Ave, Gabalfa, and Minehead Rd, Llanrumney, aged persons' homes.—See 17 Dec. issue.

7 Jan.—Glanford Brigg R.D.C. Provision, erection and maintenance of duplicate 80 g.p.m. sewage pumps complete with motors, starters and accessories for Wrawby Sewerage Scheme.—See 31 Dec. issue.

7 Jan.—Sunderland T.C. Electrical installations in 206 dwellings, Town End Farm estate.—See 24 Dec. issue.

7 Jan.—Warrington T.C. Electrical installation in mental wards at Whitecross Homes, Wakefield St for Welfare Services Committee.—See 24 Dec. issue.

8 Jan.—Bilston B.C. Supply and erection of 183 60 W sodium Group "B" lamps on 15 ft concrete columns along various roads. —See 10 Dec. issue.

8 Jan.—Kildare. Electrical installation in new vocational school. Details from G. O'Cuimin, Chief Executive Officer, Technical School, Naas.

8 Jan.—Londonderry. Electrical installation in new voluntary secondary intermediate school at Dungiven.—See 17 Dec. issue.

8 Jan.—Sunderland T.C. Electrical installation in Pallion Junior Infants' School.—See 24 Dec. issue.

9 Jan.—Glanford Brigg U.D.C. Rewiring and other electrical work in council offices. Surveyor, Bigley St.

9 Jan.—Mere P.C. Supply and erection of 41 140 W sodium discharge lamps on 1,500 yd of A303.—See 17 Dec. issue.

9 Jan.—Ormskirk U.D.C. Installation of additional power points and renewal of switchgear in 124 houses, Scarisbrick St.—Advertised 24 Dec. issue.

9 Jan.—Tunbridge Wells B.C. Supply of lamps on supplies list for year commencing 1 April, 1960.—See 31 Dec. issue.

9 Jan.—Willesden B.C. Supply of electrical equipment, cable and lamps, item 1, on supplies list for year ending 31 March, 1961. —See 17 Dec. issue.

10 Jan.—Ross and Cromarty C.C. Electrical work (contract "g") in: (1) five-apartment school house at Achtercain: (2) house at Goathill, Stornoway: (3) two blocks of two houses at Aultbea: (4) six houses at Culbokie, Black Isle.—See 31 Dec. issue.

11 Jan.—Belfast. Electrical installation in St. Augustine's Boys' Voluntary Intermediate School, Ravenhill Rd.—See 31 Dec. issue.

11 Jan.—Dundee T.C. Light and power installations in Water Dept. stores and workshops, at 12 Ward Rd. Engineer and Manager, 1 Shore Terr, Dundee.

11 Jan.—Padiham U.D.C. Conversion from 5 A, 2 pin to 13 A system in 196 houses. Housing Officer, Town Hall, Padiham.

11 Jan.—Worcester. Supply of dry batteries, lamps and car batteries. Chief Fire Officer, Copenhagen St, Worcester.

12 Jan.—Hampshire C.C. Alternative tenders (a) 24 140 W cut-off sodium lanterns on 25 ft steel or concrete columns, or (b) 12 280 W or 12 200 W sodium lanterns on 35 ft steel columns. Applications to County Surveyor, H. N. Jenner, The Castle, Winchester, by above date.

12 Jan.—Manchester T.C. Electrical installation at Nicholls Secondary School, Ardwick.—See 24 Dec. issue.

13 Jan.—Barking B.C. Supply and erection of: (A) 19 Class "A" sodium units on 25 ft columns in Renwick Rd: (B) removal of 48 existing steel columns and provision of 48 Class "A" sodium units in Longbridge Rd. —Advertised 31 Dec. issue.

13 Jan.—Blyth B.C. Supply of (item 15) cables and fittings.—See 31 Dec. issue.

13 Jan.—Durham C.C. Electrical installations in police houses at Burnside estate, Houghton-le-Spring (three pairs and office); at Harperley Hall (two pairs). Applications to County Architect, South St, Durham, by above date.

13 Jan.—Hertfordshire C.C. Supply of lamps for year to 31 March, 1961. County Purchasing Officer, Old Rectory, Hatfield.

13 Jan.—Torquay B.C. Electrical installation, using m.i.c.s. cable in Oddicombe Beach Redevelopment—cafe on fixed price basis. Borough Surveyor, Town Hall, Torquay. Deposit £2 2s. Applications by above date.

14 Jan.—Ministry of Transport. Lighting installation for tunnels, approach ramps and pedestrian subways in Hanger La, Western Ave underpass scheme.—See 24 Dec. issue.

14 Jan.—Penybont R.D.C. Provision and erection of 140 W sodium lamps on 25 ft concrete columns at: (a) Litchard/Sarn/Bryncethin (159 lamps with underground and o/h cabling): (b) Cefn Cribbwr (76 lamps): (c) Coytrahen (35 lamps).—See 31 Dec. issue.

14 Jan.—Rayleigh U.D.C. (3) Provision of 36 hot water systems in council houses. Engineer and Surveyor, Council Offices, Rayleigh.

15 Jan.—Waltham Holy Cross U.D.C. Supply, erection and wiring of 111 Class "A" concrete columns and 10 Class "B" for sodium lighting on A112 and Mott St. —See 31 Dec. issue.

16 Jan.—Burton upon Trent T.C. Supply of (item 6) lamps for street lighting and other purposes including tungsten, sodium and fluorescent tubes for year commencing 31 March, 1960.—See 31 Dec. issue.

16 Jan.—Prestwich B.C. Supply of lamps on supplies list for year ending 31 March, 1961.—See 31 Dec. issue.

16 Jan.—Seaham U.D.C. Rewiring of 265 houses on Deneside estate. Surveyor.

18 Jan.—Droxford R.D.C. Installation of immersion heaters and insulation jackets in 680 houses on fixed-price basis by approved contractors.—See 24 Dec. issue.

18 Jan.—Gillingham B.C. Supply of: (item 16) switches and accessories; (17) conduit; (18) wire, cables and accessories; (19) lamps for year commencing 1 April, 1960. Borough Engineer, Municipal Bldgs, Gillingham.

18 Jan.—Loughborough B.C. Supply and installation of two centrifugal pumps, each capable of discharging 300 g.p.m. and two a.c. motors with ancillary equipment for Derby Rd industrial site sewage. Town Clerk, A. Usher, "Southfields," Loughborough. Deposit £2 2s.

18 Jan.—St. Austell U.D.C. Provision and maintenance of three vertical spindle 1,000 g.p.m. unchokeable centrifugal pumps, complete with motors, starters, wiring and ancillary equipment for Mevagissey Sewerage.—See 17 Dec. issue.

18 Jan.—Faversham B.C. Supply and erection of 11 140 W sodium discharge lamps on prestressed concrete columns with brackets at Stone St. Borough Surveyor, Municipal Offices, Faversham. Deposit £2 2s.

18 Jan.—Flintshire C.C. Supply of various types of bulbs (item 25) and (item 27c) batteries for period to 31 Dec., 1960. County Surveyor, E. W. Richards, County Bldgs, Mold.

18 Jan.—Hayes and Harlington U.D.C. Supply of (item 16) conduit, fittings and accessories: (17) street lighting discharge lamps: (18) g.l.s. and automobile lamps; (19) c.i. and concrete lighting columns; (21) m.v. and l.v. cables: (28) time switches. Engineer and Surveyor, Town Hall, Hayes, Middx.

18 Jan.—Southampton T.C. Electrical installation at Glen Eyre Secondary Girls' School. —Advertised 31 Dec. issue.

18 Jan.—Twickenham B.C. Supply of street lighting columns and fittings, cables, conduit and lamps for year from 1 April, 1960. Borough Engineer and Surveyor, Municipal Offices, Twickenham.

18 Jan.—Westminster T.C. Supply of lamps for year commencing 1 April, 1960.—See 24 Dec. issue.

19 Jan.—Kingston upon Thames B.C. (c) Wiring for lighting of 58 market stalls. —See 31 Dec. issue.

19 Jan.—Londonderry C.C. Electrical, heating and plumbing installations in primary school extension.—See 24 Dec. issue.

20 Jan.—Carlisle T.C. Erection of 120 Group "B" street lighting units with either mercury or sodium lighting. County Engineer, L. J. A. Stow, 18 Fisher St, Carlisle.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 101 queries answered this week

"Rodene" relays—makers of? B.B.C.—Rodene Electrical Co. Ltd., 717 London Rd, Hounslow, Middx.

"Richard" shavers — agents for? H.T.J.—B. H. Ries Ltd., 19/21 Hatton Gdn., E.C.1.

"Jeani" lampholders — makers of? L.E.B.—Fitzgibbon and Murray Ltd., Smallfield Wks, Horley, Surrey.

"PEC" switchgear—makers of? R.M.L. —Power Equipment Co. Ltd., Kingsbury Wks, Kingsbury Rd, Hendon, N.W.9.

"Tower Light" lighting fittings—address for? B.L.C.—Stadium Ltd., 30/36 Queensway, Ponders End, Enfield, Middx.

"Scintilla" electric shears—address for? T.B.C.—Scintilla Ltd., Carlisle Rd, N.W.9.

"Easyfix" switch-plug—makers of? S.W.E.B.—Mycalex and T.I.M. Ltd., Ashcroft Rd, Cirencester, Glos.

"Comyn Ching" bell pushes—makers of? W.C.—Comyn Ching and Co. (London) Ltd., 15 Shelton St, W.C.2.

"Raydyot" lamps—makers of? S.E.—James Neale and Sons Ltd., 68 Graham St, Birmingham 1.

20 Jan.—Feltham U.D.C. Supply of lamps, item 4 on supplies list for year commencing 1 April. Engineer and Surveyor's Dept., Council Offices, Feltham, Middx.

20 Jan.—Wallasey T.C. Supply of cables (item 14) and (item 15) lamps for supplies list for year ending 31 March, 1961.—See 31 Dec. issue.

20 Jan.—Worthing B.C. Supply tungsten lamps (item 13) and (14) discharge lamps for year to 31 March, 1961. Borough Engineer, Town Hall, Worthing.

21 Jan.—Newcastle-on-Tyne T.C. Supply and installation of two automatic passenger lifts in each of six 15-storey blocks of flats at Pottery Bank, Westgate Rd and Church St, Walker.—See 17 Dec. issue. Supply and installation of lightning protection equipment in six blocks of flats from 12 to 15 storeys high at Heaton Pk Rd, Cruddas Pk and Shieldfield.—See 31 Dec. issue.

22 Jan.—Aberdare U.D.C. Supply of, item 14, lamps for year to 31 March, 1961. Engineer and Surveyor, Vestry Hall, Aberdare.

22 Jan.—Belfast T.C. Supply of: (1) turbine oil; (2) transformer oil; (3) fireclay, etc.; (5) carbon brushes; (6) steel wire rope; (8) glazed stoneware ducts; (9) distribution and street lighting pillars; (10) 6·6 kV indoor metalclad switchgear; (11) meters, instrument transformers, etc.; (12) m.d. indicators; (13) time switches; (14) l.t. fuse units, etc.; (15) transformers; (18) washboilers; (19) kettles; (21) cookers.—Advertised 31 Dec. issue.

22 Jan.—Norwich T.C. (1) Supply of 62 200 W, 39 140 W medium angle and 20 140 W cut-off type SO/H lanterns; (2) supply of control gear and lamps; (3) supply of 121 tubular steel columns; and (4) erection and part connection for (a) A11 Newmarket Rd, (b) Thorpe Rd and main traffic route and (c) Harvey La. City Engineer, City Hall, Norwich.—Advertised in this issue.

23 Jan.—Camborne-Redruth U.D.C. Supply of electrical equipment and fittings, item 24, on list for year ending 31 March, 1961.—See 10 Dec. issue.

23 Jan.—Nottingham T.C. Supply of, item 2, lamps for E.C. Director of Education, W. G. Jackson, Exchange Bldgs, Nottingham.

23 Jan.—Swansea T.C. Supply of lamps, cables, public lighting equipment, concrete and steel columns for supplies list.—Advertised 31 Dec. issue.

25 Jan.—Manchester T.C. Installation of 6·6 kV cables, road lighting and telephone cables at Davyhulme Sewage Wks extensions, stage 1B. City Surveyor, Town Hall, Manchester.—Advertised in this issue.

25 Jan.—Wembley B.C. Supply of lamps, item 9, on supplies list for year commencing 1 April, 1960. Maintenance and Transport Engineer, Town Hall, Wembley.

26 Jan.—Blackburn T.C. Maintenance of school meals canteen equipment (item 2b) electric and (item 2c) refrigerators for year from 1 April, 1960. Education Offices, Library St, Blackburn.

28 Jan.—Gainsborough U.D.C. Conversion of hand-operated service lift to electric drive in Town Hall. Engineer and Surveyor, Council Offices, Lord St, Gainsborough.

28 Jan.—Gt. Yarmouth T.C. Electrical installation in new H.Q., police station at Howard St South.—See 24 Dec. issue.

28 Jan.—Luton B.C. Erection and wiring only of 440 Class "B" concrete lighting columns with sodium discharge lighting. Borough Engineer, Town Hall, Luton. Deposit £2 2s.

29 Jan.—Churchdown P.C. (1) Supply of 94 140 W sodium aero-screened lanterns with ancillary equipment; (2) supply and erection of 94 steel columns together with fitting and wiring of tenderer's own lighting equipment; (3) as (2) but for fitting and wiring of equipment offered by another firm.—Advertised 31 Dec. issue.

3 Feb.—Machrihanish. Electrical work in connection with runway extension, etc., including: (a) lighting installation including runway and approach systems; (b) h.v. and m.v. cable installations extensions; (c) connecting of cables, switchgear, transformers, etc., in substations and lighting in substations and control building. N.A.T.O. Common Infrastructure Contract Slices VII and VIII, value £105,000. Applications to Civil Engr. in Chief, Admiralty, Chamberlain Way, Pinner, Middx, by above date.

10 Feb.—Lancaster T.C. Supply and installation of: (1) three low lift pumps (two of which working together to deal with 3,050 g.p.m. and 4,500 g.p.m.); (2) three high lift pumps (two of which for 2,778 and 4,167 g.p.m.), for River Lune Scheme. City Engineer, Town Hall, Lancaster. Deposit £2.—Advertised in this issue.

No date stated—Hertfordshire C.C. Applications invited for inclusion on list for electrical work. Clerk of the County Council, County Hall, Hertford.

No date stated—Calne B.C. Installation of immersion heaters together with ancillary wiring in 250 dwellings. Borough Surveyor, Patford Hse, Calne.

No date stated—Ayr C.C. Supply of: (1) standards; (2) electrical equipment; (3) erection work: (4) 140 W SO/H lanterns for Hurlford Trunk Rd-Ayr and Prestwick By-pass Rd roundabout lighting.—See 31 Dec. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

22 Jan.—S. Africa. Two 66 kV, 1,500 MVA, and three 33 kV, 1,000 MVA circuit-breakers and protective equipment. Tender C8066. Chairman of the Tender Board, P.O. Box 7784, Johannesburg. B.o.T. (ESB/30115/59).*

4 Feb.—Guatemala. Complete 100 kVA hydro-electric plant for Municipality of Santa Maria Cahabon, Dept. of Alta Verapaz. Secretaria, El Instituto de Fomento Municipal, 8A Calle 9-41, Segundo Piso, Zona 1, Gautemala City. B.o.T. (ESB/29631/59).*

12 Feb.—S. Africa. Twelve 10 kVA, 3-ph. transformers for 6·6/0·4 kV and 12 for 11/0·4 kV. Town Clerk, City Hall, Durban. B.o.T. (ESB/29430/59).*

16 Feb.—India. Turbines, generators, transformers, switchgear, control equipment, lightning arresters and earthing material. SE.4241K/1. Director-General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (ESB/29495/59).*

26 Feb.—Australia. Section "A," one 72 MVA, 3-ph. 110/11·8 kV oil immersed transformer; Section "B," one 30 MVA 3-ph. 110/33 kV oil immersed transformer. Town Clerk, City Hall, Brisbane. B.o.T. (ESB/28612/59).*

Gazette Announcements

COMPANIES ACTS

Phoenix (Electrical Contractors) Ltd. Mr F. R. Hews, Tudor Court, 52 Richmond Rd, Worthing, Sussex, appointed liquidator as from 14 Dec.

W. R. S. Horne Ltd. Last day for receiving proofs for intended dividend: 15 Jan., to liquidator: Mr R. F. Bendall, 126 Colmore Row, Birmingham 3.

Strud Products Ltd. Mr A. Sutherland, 20 Southampton Pl, W.C.1, appointed liquidator at extraordinary general meeting on 7 Dec., for the purpose of voluntarily winding-up.

J. and R. Appliances Ltd. Petition for winding-up to be heard before the Royal Courts of Justice, Strand, W.C.2, on 11 Jan. Persons intending to appear to notify H. Mortlake and Co., 247 High Rd, Ilford, Essex, by 1 p.m., 9 Jan.

Davis Refrigeration Co. Ltd. Petition for winding up to be heard before the Royal Courts of Justice, Strand, W.C.3, on 11 Jan. Persons intending to appear to notify Cochrane and Cripwell, 119 Finsbury Pavement, E.C.2, by 1 p.m., 9 Jan.

Midland Refrigeration and Electrical Co. Ltd. Meeting of credtiors to be held at 93 Queen St, Sheffield 1, on 14 Jan. at 2.45 p.m.

Frigonics Ltd. First meetings of creditors and contributories to be held at Official Receiver's Office, 20 North Parade, Bradford, on 12 Jan., at 11 and 11.30 a.m. respectively.

Scott Wilson (Electrical) Ltd. Meeting of creditors to be held at 76 New Cavendish St, W.1, on 12 Jan. at 11.30 a.m.

BANKRUPTCY ACTS

Public Examination

Luton. T. B. Jones, electrical manufacturer, of 65 Totternhoe Rd, Dunstable. Public examination: 11 a.m., 18 Feb., at Court Hse, Stuart St, Luton.

Receiving Order

Cardiff. G. B. Bullen, electrician, 58 Canada Rd, Cardiff. Receiving order dated 30 Dec.

Intended Dividends

Burton-on-Trent. M. Horton and A. E. Wheildon, electrical and mechanical engineers, formerly carrying on business in co-partnership as Monarch Electrics, at 6 Victoria Rd, Burton-on-Trent. Last day for receiving proofs for intended dividend: 12 Jan., to trustee: Mr A. W. Hunter, Walter Hse, 418/422 Strand, W.C.2.

Portsmouth. S. R. L. Sutton, electrical dealer, carrying on business as S. Sutton and Sons, at 127 Sultan Rd, Portsmouth. Last day for receiving proofs for intended dividend: 9 Jan., to trustee: Mr A. H. Horler, 16 Westwood Rd, Southampton.

Dividends

Ashton-under-Lyne. J. Darwen, electrical engineer, formerly carrying on business at Dane Bank Hse Wks, Windmill La, Denton, and at 23 Reddish La, Gorton. Dividend per £: 1s 8¼d, payable at Official Receiver's Office, 20 Byrom St, Manchester 3, on 8 Jan.

Manchester. F. J. Critchley, electrical engineer, carrying on business at 9 York St, Hulme, and formerly at 304 Deansgate. Dividend per £: 1s 1¾d, payable at Official Receiver's Office, 20 Byrom St, Manchester 2, on 12 Jan.

TRADE NOTES

Changes of Address. The London office of the British Welding Research Association has moved to 19 Fitzroy Sq, W.1. Telephone Euston 9595.

As from 11 Jan. the London office of the Wandsworth Electrical Manufacturing Co. Ltd. will be at Portman Chmbrs, 7/9 Baker St, W.1. Telephone Hunter 3201.

Change of Name. The name of Claude-General Neon Lights Ltd. has been changed to Claudgen Ltd.

New 'Phone No. The telephone number of Electropol Processing Ltd. has been changed to Farnham 3355.

Sales Area. Nife Batteries are setting up an additional sales engineering area. Known as the North Midlands area, it will include Sheffield, Barnsley, Doncaster, Scunthorpe, Derby, Nottingham and Lincoln and surrounding districts. Mr P. Sandels is engineer-in-charge, operating from 4 Ordsall Pk Rd, Retford. Telephone: Retford 2330.

BUSINESS PROSPECTS

Home

Abercarn U.D.C. Erection of 152 houses at Trincint site, Crumlin. Engineer.

Abertillery U.D.C. Erection of 126 dwellings being housing development at Swffryd site "C," Crumlin. Architects: Geo. H. Davies and Hurley, 12 Cross St, Abergavenny, Mon.

Armagh C.C. Sketch plans for £80,000 old people's home at Gilford Rd approved by Co. W.C.

Banbury B.C. Supply and erection of pumps, motors, pipework and valves to deal with five cusecs of crude sewage. Consulting Engineers: J. D. and D. M. Watson, 67 Tufton St, S.W.1.

Barnsley B.C. Recommended to approve erection of 300 dwellings in 1960 programme.

Bath T.C. Expansion of teaching and residential accommodation at Training College, Newton Pk. Architects: Gerrard, Taylor and Partners, 4/5 Bridge St.

Belfast T.C. Smyth and Cowser, 31 College Gdns, are architects for new £80,000 bus terminal.

Brighouse. J. Blakeborough and Sons Ltd. are to extend works at Birds Royd.

Brighton T.C. Clayton, Black and Daniel, 16 Dartmouth St, S.W.1, are recommended as architects for factory to be erected in two stages, £44,000 and £10,000, at Lower Bevenden industrial area to be leased to West Instruments Ltd.

Chertsey U.D.C. Erection of 20 maisonnettes at Green La, Addlestone. Engineer and Surveyor.

Cheshire C.C. £180,370 Sutton Secondary School for Girls approved by Co. E.C.

Chester. £260,000 new out-patients' dept. at Royal Infirmary for Liverpool Regional Hospital Board planned.

Coventry T.C. Erection of two-form-entry junior school at Potters Green. City Architect.

Crewe B.C. Propose erection of 60 houses in Naylor St and 80 in Middlewich St during 1960.

Cromer R.D.C. Have approved outline application for factory near Shipden Ave for Argent Box Co. Ltd., 225 Southwark Bridge Rd, S.E.1.

Cumberland C.C. Have approved the principle of installation of electric immersion heaters in 240 police houses at cost £3,000, the work to be carried out over three years.

Darwen B.C. Recommended to approve £130,000 three-storey flats in Hanover St redevelopment scheme.

Dewsbury T.C. Erection of 46 dwellings in Batley Carr redevelopment scheme No. 1. Borough Architect.

Durham C.C. Plan the erection of a modern school at Whickham.

East Suffolk. Erection of £60,000 old people's home at Stowmarket approved by P.H.C.

Essex. Standing Joint Committee to apply for approval for £108,000 H.Q. extensions at Chelmsford, £90,000 divisional H.Q. at Romford, £60,000 divisional H.Q. at Basildon New Town centre, and £25,000 subdivisional H.Q. at Ongar.

Gateshead. A. E. Gunning, 18 Eldon Sq, Newcastle-on-Tyne, is preparing plans for St. Peter's Church at Kells La/Weathercock La, for Rev Father J. Anderson.

Glasgow T.C. Erection of secondary school, Danes Dr, Scotstoun. City Architect, 20 Trongate. Housing sub-committee on sites and buildings have approved £1,387,000 scheme at Blairtummoch, Easterhouse, involving 674 dwellings.

Gloucestershire C.C. Recommended to apply for loan sanction of £240,740 for Chipping Campden Grammar School extension: of £161,335 for Cirencester Modern School for Boys: of £116,045 for Winchcombe Secondary School.

Guildford. G. Baines and Syborn, 121 Victoria St, S.W.1, are architects for £1 million department store in High St for Debenhams Ltd.

Halifax B.C. Erection of branch library at Mixenden. Borough Engineer.

Hetton U.D.C. Have applied for loan sanction of £28,707 for 18 houses at Lindsay St.

Houghton-le-Spring U.D.C. Erection of 42 houses on Burnside estate. Engineer and Surveyor.

Hove B.C. Erection of 24 flats in Egmont Rd. Borough Engineer and Surveyor.

Leamington Spa B.C. Planning permission for light industry site in Althorpe St redevelopment area granted by Ministry.

Leeds T.C. Layout development on 6·65 acres in Woodhouse St and Servia Hill area (206 dwellings and shops) and on 7·79 acres Dixon La/Greenside Rd/Lower Wortley Rd area (247 dwellings) approved by H.C.

Liverpool T.C. Supply and installation of plant and machinery in new public laundry and baths, St. Domingo Rd Baths. Manager and Engineer, 62 Fontenoy St, Liverpool 3.

Maidstone B.C. Plan erection of 250 dwellings and 50 old people's flats in 1960 programme.

Middlesbrough T.C. Proposes to erect maternity and child welfare clinic at Carlow St at cost of £15,000, and clinic at Berwick Hills at £17,000. E.C. have approved plans and estimates for Easterside Primary School (£62,030), and additions to St. Joseph's R.C. Primary School.

Middlesex C.C. Have approved the erection of final phase (£35,153) of Cardinal Wiseman R.C. Secondary School and £116,360 extension and adaptations at Drayton Manor County School.

Milford Haven U.D.C. Erection of 95 houses in Gelliswick scheme. Engineer and Surveyor.

Morley. D. O. Feast, 20 Woodstock St, W.1, is architect for conversion to supermarket in Queen St for Howard Collings Group of Companies, 10 Curzon Pl, W.1.

Oxford. £250,000 extensions at Radcliffe Infirmary for United Oxford Hospitals approved by Ministry.

Paignton U.D.C. Erection of block of 19 flatlets for old people at St. Michael's Rd. Deputy Clerk of the Council, Municipal Offices, Oldway.

Peterhead B.C. Propose 104 dwellings at Clerkhill and Catto Dr schemes.

Reading T.C. Supply and erection of "No-choke" centrifugal pumps plants at Manor Farm Sewage Disposal Works: (i) one 1,500 g.p.m. and two 750 g.p.m. pumps at Upper Whitley; (ii) two 500 g.p.m. at digested sludge pumping station. Consulting Engineers: Howard Humphreys and Sons, Victoria Stn Hse, Victoria St, S.W.1. Deposit £5 5s.

Rippenden U.D.C. To apply for £34,000 loan sanction for 24 houses on Rishworth Hall estate.

Selkirk T.C. Erection of 55 houses in 16 blocks at Bannerfield estate. Architects: Basil Spence and Partners, 40 Moray Pl, Edinburgh 3.

Somerset C.C. Erection of 520-place Clevedon Secondary Modern School. County Architect, The Crescent, Taunton.

Stirlingshire C.C. Technical college at Randyford approved by E.C.

Stowmarket. £129,400 additions and alterations at Stow Lodge Hospital planned by E. Anglian Regional Hospital Board.

Taunton B.C. Erection of 22 dwellings on Lane estate. Borough Architect, Flook Hse, Station Rd.

Valley R.D.C. Erection of 50 Unity dwellings at Tan-y-Bryn. Clerk of the Council, Valley, Holyhead.

Walthamstow B.C. Erection of 4,000 sq ft factory at Grange Rd. Borough Architect.

Wigan T.C. Erection of 50 dwellings on Wilfred Rd site. Borough and Water Engineer, Library St.

Wrexham T.C. Erection of 24 dwellings at Tarat Way, Queens Pk Nth. Borough Engineer and Surveyor, 31 Chester St.

Yeovil B.C. Potter and Mare, De Vaux Hse, De Vaux Pl, Salisbury, are architects for new £125,000 town hall at Hendford Manor.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Communiscope. 779,720. Class 9. Electric, electronic instruments, etc. U. R. Farner, Theaterstrasse 8, Zurich, Switzerland.

Decca Varitrack. 786,061. Class 9. Scientific apparatus, etc. Decca Record Co. Ltd., 9 Albert Embankment, S.E.11.

Flasherking. B789,805. Class 11. Hand lamps. Meyer Mnfg. Co. Ltd., 55 Kowloon City Rd, To-kwa-wan, Kowloon, Hong Kong.

General Ermetic. 781,112. Class 7. Refrigerator compressors, washing machines, ironing machines, etc. 785,113. Class 11. Refrigerators, etc. Compagnie Francaise Thomson-Houston, 173 Boulevard Haussmann, Paris (8e), France.

L'Avenair. 786,163. Class 7. Washing machines, etc. J. Hellier, Victoria Hse, 26 Victoria St, Luton, Beds.

OR in design. B791,124. Class 9. Apparatus, etc. Otto Ramstetter Fabrik Electrotechnischer Apparate, Bruderhofstrasse 28-30, Munich 25, Germany.

Pepril. 783,913. Class 9. Apparatus. Pechiney-Progil (S.A.) Societe pour le Developpement et la Vente de Specialities Chimiques, 7 Rue Lamenais, Paris 8, France.

Rayseal. B789,294. Class 7. High frequency electronic machines for bonding plastics, paper, etc. Raybond Electronics Inc., 66 Needham St, Newton Highlands 61, Massachusetts, U.S.A.

Summit. 786,679. Class 7. Clothes washing machines and centrifugal drying machines. P. T. Butler, 2 Dalbury Rd, Hall Green, Birmingham 28.

Sylflex in design. 789,646. Class 7. Machines for treating leather. Dow Corning Corpn., City of Midland, Michigan, U.S.A.

Triaxiette. B791,178. Class 9. Moving coil loudspeakers, etc. Goodmans Industries Ltd., Axiom Wks, Lancelot Rd, Wembley, Middx.

CONTRACTS PLACED

Boldon U.D.C. Supply of materials for rewiring old council houses, J. Gledson and Co. Ltd., £1,664.

Newcastle. Electrical work in hospitals for Regional Hospital Board: in residential accommodation at Winterton Hospital, Cox Walkers Ltd., £735; at Walkergate Hospital, Cairns Ltd., £332; installation of X-ray equipment at Morpeth Cottage Hospital, Philips Electrical Co., £397; in new X-ray dept. at Chester-le-Street General Hospital, Fairbairn and Partners, £523; in occupational therapy unit at St. George's Hospital, J. Robinson Ltd., £350 18s.

Oxford T.C. Improvements to electrical installations at: Cuttesloe No. 1 estate, 148 houses, Williams Bros. (Electrical) Ltd., £4,296; Cuttesloe No. 2 estate, 128 houses, K. N. Slatter, £3,926; Gipsey La estate, H. A. Nunn and Son, £4,439. Recommended.

MEETINGS TO NOTE

THURSDAY, 7 JAN.

I.E.E. Hunter Memorial Lecture, "The Protection of Electrical Systems," H. G. Bell. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Western Centre). "The Deltic Locomotive," C. M. Cock. Swindon Technical College. 6 p.m.

FRIDAY, 8 JAN.

I.E.E. (Medical Electronics Discussion Group). "Electrical and Electronic Techniques in Respiratory Research." Savoy Pl, W.C.2. 6 p.m.

I.E.E. (E. Anglian Sub-centre). Annual dinner/dance. Dorothy Restaurant, Cambridge. 7.30 p.m.

A.S.E.E. (Liverpool Branch). "Control Centres for Modern Industry," R. Ritchie. M.A.N.W.E.B. Industrial Development Centre, Paradise St, Liverpool 1. 7.45 p.m.

E.P.E.A. "Tariffs for Electrical Supply," A. E. Marchant. Tudor Room, Caxton Hall, S.W.1. 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Fawley Section). "Quality Control," Dr Millership. Admin. Bldg, Esso Refinery, Fawley. 5.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Midland Section). "Control Systems as Applied to Railway Signalling," J. C. Kubale. Lecture Theatre, Byng Kendrick Suite, Gosta Green College of Technology, Aston St, Birmingham. 7 p.m.

INSTITUTE OF FUEL (S.E. Section). "Nuclear Power," N. D. Norris. Dunning Hall, Week St, Maidstone. 7 p.m.

MONDAY, 11 JAN.

I.E.E. (Electronics and Communications Section). Three papers on Modulators. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N.E. Centre). "Research on the Performance of H.V. Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Neville Hall, Westgate Rd, Newcastle-on-Tyne. 6.15 p.m.

I.E.E. (S. Midlands Supply and Utilisation Group). "Electrical Supplies to Power Station Auxiliaries," D. A. Dewsnap. College of Technology, Gosta Green. 6 p.m.

I.E.E. (Western Centre). "The Application of Low-pressure Resins to Some H.V. Switchgear Designs," T. R. Manley, K. Rothwell and W. Gray. Bristol University. 6 p.m.

A.S.E.E. (Bournemouth Branch). "New Methods and Techniques in the Electrical Industry," Dr H. G. Taylor. Grand Hotel, Firvale Rd, Bournemouth. 8 p.m.

A.S.E.E. (C. London Branch). "Present-day Computers," W. F. M. Payne. White Hall Hotel, Bloomsbury Sq, W.C.1. 7.15 p.m.

I.E.S. (Sheffield Centre). Presidential address, H. G. Campbell. Grand Hotel, Sheffield. 6.30 p.m.

E.P.E.A. "Condensing and Feed Heating Plant," J. Gibbins. Lancaster Room, Caxton Hall, S.W.1. 7 p.m.

TUESDAY, 12 JAN.

I.E.E. (N.E. Centre). "Submersible Pumping Plant," H. H. Anderson. Workington College of Further Education. 7 p.m.

I.E.E. (N.W. Utilisation Group). "The Characteristics and Protection of Semiconductor Rectifiers," D. B. Corbyn and N. L. Potter. Engineers' Club, Albert Sq, Manchester. 6.15 p.m.

I.E.E. (N. Ireland Centre). "Generator/Motor Problems in Pumped-Storage Installations," J. H. Walker. David Keir Bldgs, Queen's University, Stranmillis Rd, Belfast. 6.30 p.m.

A.S.E.E. (Chester Branch). "Flameproof Electrical Equipment," W. T. Partington. Westminster Hotel, City Rd, Chester. 7.45 p.m.

A.S.E.E. (Glasgow Branch). "Modern Lighting Technique," M. J. Powley. Kenilworth Hotel, Queen's St, Glasgow C.1. 8 p.m.

WEDNESDAY, 13 JAN.

I.E.E. (Supply Section). "Gaseous Discharge Phenomena in H.V. D.C. Cable Dielectrics," F. C. Rogers and D. J. Skipper. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Lancs Sub-Centre). "Electrification of the U.K.A.E.A. Industrial Group Factories," J. W. Binns and W. J. Outram. N.W. Electricity Board Demonstration Theatre, Friargate, Preston. 7.15 p.m.

I.E.E. (N. Midlands Graduate and Student Section). "The Use of Electricity in Hazardous Atmospheres," P. A. D. Sheen. Strafford Arms Hotel, Wakefield. 7 p.m.

I.E.E. (Sheffield Graduate and Student Section). "Programming," P. N. Baker. Technical College, Chesterfield. 7 p.m.

A.S.E.E. (Birmingham Branch). "Transformers," F. Yates. Birmingham Exchange and Engineering Centre, Birmingham 2. 7.30 p.m.

A.S.E.E. (Luton Branch). "Lubricating Oil and Greases and their Application in Industry," W. A. Ward. Luton College of Technology, Park Sq. 8.15 p.m.

A.S.E.E. (S.E. London Branch). "The Engineer in Chemical Manufacturing," A. F. Hickford. Eltham Green School, Queenscroft Rd, S.E.9. 7.45 p.m.

WOMEN'S ENGINEERING SOCIETY. "Health Physics and Nuclear Power," B. C. Godbold. "Hope Hse," 45 Gt. Peter St, S.W.1. 7 p.m.

INSTITUTION OF PLANT ENGINEERS (Dundee Branch). "Surveying Electrical Equipment to Comply with the Factories Act," J. Townsley. Taypark Hotel, West Ferry, Dundee. 7.30 p.m.

NEWPORT AND DISTRICT ELECTRIC CLUB. "Safety in the Use of Electricity—Fire and Explosion Risk," S. J. Emerson. King's Head Hotel, Newport. 6.30 p.m.

MINISTRY OF WORKS. "Artificial Lighting for Modern Buildings," J. B. Harris. Royal Society Hall, 24 George St, Edinburgh. 7.15 p.m.

I.E.S. (Edinburgh Centre). "Hospital Lighting," G. R. N. Chalmers. Y.M.C.A. Social Room, 14 South St, Andrew St, Edinburgh. 6.15 p.m.

I.E.E. (Bristol Graduate and Student Section). "A New Method of Analysis for Single-Phase Motors," J. Rye. Lecture Theatre, Cabot Hse, College of Technology, Ashley Down, Bristol. 7 p.m.

THURSDAY, 14 JAN.

I.E.E. (Utilisation Section). "The Application of Power Transistors to the Operation of Gas Discharge Lamps from d.c. Supplies," L. F. Davies and D. Dunthorne. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Scotland Sub-Centre). "The Deltic Locomotive," C. M. Cock. Electrical Eng. Dept., Queen's College, Dundee. 7 p.m.

I.E.E. (W. Wales Sub-Centre). "Silicone Electrical Insulation," J. H. Davies. Conference Room, S.W.E.B. Showrooms, The Kingsway, Swansea. 6 p.m.

INSTITUTION OF PLANT ENGINEERS. "Selection of Heating Systems for Factories and Offices," T. Turner. Scottish Bldg Centre, Sauchiehall St, Glasgow. 7.15 p.m.

INSTITUTE OF PHYSICS (Liverpool Branch). "Electronic Applications of Superconductivity," Dr E. Mendoza. Liverpool University. 7 p.m.

I.E.S. (Manchester Centre). "Lighting as an Aid to Police Photography," Det.-Sergt. H. Martin. Demonstration Theatre, Town Hall Extension, Manchester. 6 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Liverpool Section). "The Genealogy of Remote Control," A. L. Hancock. M.A.N.W.E.B. Industrial Development Centre, Paradise St, Liverpool. 7.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (S. Yorks Section). "Automatic Analytical Instruments," G. H. Moss. John Leggot Grammar School, Coal St, Scunthorpe. 7.30 p.m.

FRIDAY, 15 JAN.

I.E.E. (Utilisation Section). Dinner-dance. Café Royal. 7 p.m.

I.E.E. (N. Scotland Sub-Centre). "The Deltic Locomotive," C. M. Cock. Robert Gordon's Technical College, Aberdeen. 7.30 p.m.

I.E.E. (N.E. Graduate and Student Section). "The Design of Power Transformers by Digital Computer," A. C. Hall. Grey Hall, King's College, Newcastle. 6.30 p.m.

INSTITUTE OF PLASTICS (Midlands Section). "Plastics in Electronics," Dr H. A. K. Eden. James Watt Memorial Institute, Gt. Charles St, Birmingham. 6.30 p.m.

INSTITUTE OF PHYSICS (S. Western Branch). "Science on Television," A. J. Garratt. Bristol University. 7 p.m.

INSTITUTE OF PHYSICS (S. Wales Branch). "The Microstructure of Crystalline Solids," Dr J. W. Menter. College of Technology, Newport. 6 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Crouchman and Perry Ltd., 63 London Rd, Enfield, Middx. To carry on business of electrical contractors and retailers, etc. Nom. cap.: £1,000. Dirs.: Bernard Crouchman and Alan V. Perry.

Dipping Equipment Ltd., 1/3 Whitfield St, Gloucester. To acquire patents; inventors, designers, manufacturers of and dealers in chemical, photographic, electrical, mechanical, engineering, industrial, commercial and domestic equipment, etc. Nom. cap.: £100. Dirs.: Robert L. A. Hook and Charles T. R. Shepheard.

Discartel Ltd., Burtons Chmbrs, Church St, Runcorn. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £100. Dirs.: B. S. Stowell and H. F. Todd.

Maurice A. Harris Ltd., 141 Streatham High Rd, S.W.16. Electricians, etc. Nom. cap.: £2,000. Dirs.: Maurice A. Harris, Donald G. Mitchell and Joseph Harney.

H. B. Lighting Co. Ltd., 2 The Broadway, Herne Bay, Kent. Electrical equipment specialists, etc. Nom. cap.: £500. Dirs.: Charles H. Johnstone and May Johnstone.

Home Electrics (Rental Services) Ltd., 31a/35 South Rd, Southall, Middx. Nom. cap.: £100. Dirs.: Harry E. Golding and Ivy J. Golding.

Inertia Switch Ltd., Craven Hse, 121 Kingsway, W.C.2. Electrical, mechanical and electronic equipment specialists, etc. Nom. cap.: £5,000. Dirs.: Henry Kremer and Walter W. H. Clarke.

Morphy-Richards (Cray) Ltd., St. Mary Cray, Kent. Manufacturers of and dealers in electrical and other equipment and apparatus, etc. Nom. cap.: £100. Dirs.: Donald W. Morphy and Charles F. P. Richards.

Municipal Appliances Co. Ltd., Hecla Wks, Bamber Bridge, nr. Preston. To take over business of engineers carried on at Bamber Bridge by Hecla Manufacturing Co. Ltd.; to carry on business of manufacturers of and dealers in engines, boilers, etc. Nom. cap.: £47,000. Dirs.: George S. Molyneux, Robin S. Dewhurst, Richard H. B. Dewhurst and George P. Dewhurst.

Neon Plastic Signs Ltd., Chancery Hse, Chancery La, W.C.2. Nom. cap.: £100. Dir.: Ivy Walker.

Recordit Ltd. To establish and promote shops, showrooms and other selling media for the sale of domestic appliances of all kinds, including tape recorders, etc. Nom. cap.: £5,000. Dirs.: to be appointed by subscribers. Subs.: Leslie C. Toms and Lila M. Chester.

G. A. Rix Ltd., Victory Wks, Dalton La, Keighley. To take over business of an electrical engineer carried on at Keighley by Gordon A. Rix, etc. Nom. cap.: £15,000. Dirs.: George A. Rix, John G. Rix and Morgan H. Rix.

Sound Centres Ltd., 23 The Vineyard, Abingdon, Berks. Electronic and automation engineers, etc. Nom. cap.: £100. Dirs.: Gordon Roberts and Mavis Y. Roberts.

Trolex Agencies Ltd., Kennedy St, Manchester 2. Suppliers and manufacturers of switchgear, relays, instruments, etc. Nom. cap.: £2,000. Dirs.: Dudley J. Hopley, Frederick J. Hopley and William B. Browne, C.B.E.

Tutchings Electronics Ltd., 14 Rookhill Rd, Friars Cliff, Christchurch, Hants. Nom. cap.: £1,000. Permanent dirs.: Alec Tutchings and Nora M. Tutchings.

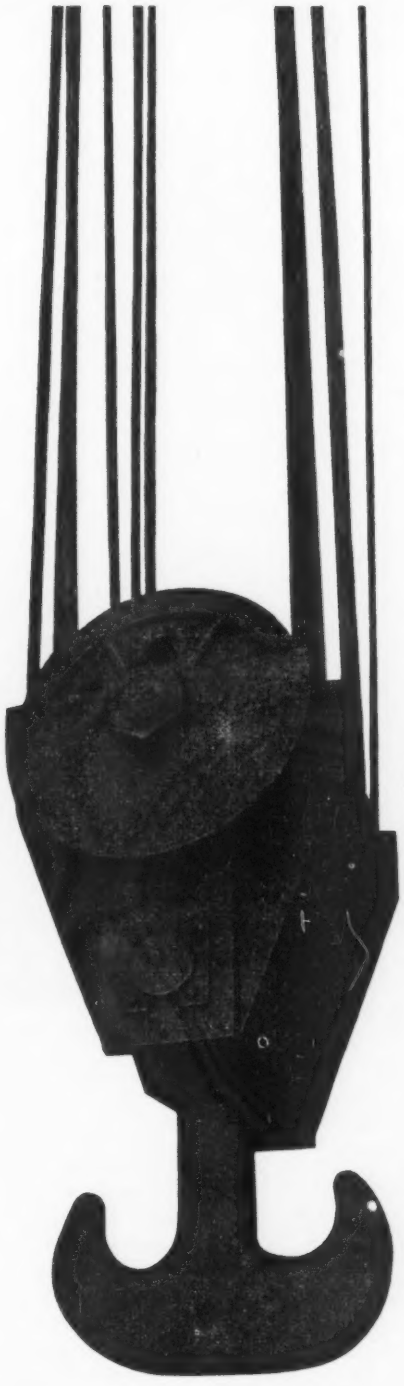
Valectric Ltd., Gathorne Hse, Roundhay Rd, Leeds 8. Manufacturers of and dealers in wireless electrical appliances, etc. Nom. cap.: £10,000. Dirs.: not named. Subs.: Edward F. Griffin and Harry Gillson.

W. Watson & Glover (X-Ray) Ltd., 2 Easy Row, Birmingham 1. To take over business of X-ray, scientific, electro-medical and optical engineers and dealers carried on as "W. Watson and Glover," etc. Nom. cap.: £5,000. Permt. dirs.: Derek C. L. Hyde and Mrs Madeline S. Hyde.

Willards' Electrical Services Ltd., 10 South Pallant, Chichester. To carry on business of electrical engineers, etc. Nom. cap.: £10,000. Permanent dirs.: Herbert E. Willard and John H. Willard.

C. F. Yates Ltd., 275 Chorley Rd, Swinton, Lancs. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £2,500. Dirs.: Phyllis M. Lucas and Charles F. Yates.

TO LIFT THE LARGEST ALTERNATORS YET ENVISAGED



The hook of the 175 ton 'traveller' in our new turbine shop at Hartlepool. Here we can build, to Brown Boveri design, the largest turbo-alternators yet envisaged. At Hartlepool we, of course, also build small turbines, and many other things besides: industrial turbo-alternators down to 500 kW, gas turbines axial and centrifugal blowers and exhausters, water-tube boilers of Foster-Wheeler design, Economic type boilers, feed heaters, condensers, rotary cooling-water strainers, etc . . . in fact all the major equipment of a power station.

R W G

RICHARDSONS WESTGARTH (HARTLEPOOL) LTD.

A member of THE RICHARDSONS WESTGARTH GROUP which co-ordinates the land and marine activities of:

THE NORTH EASTERN MARINE ENGINEERING CO. LTD. — RICHARDSONS WESTGARTH (HARTLEPOOL) LTD.

PARSONS MARINE TURBINE CO. LTD. — THE HUMBER GRAVING DOCK & ENGINEERING CO. LTD.

GEORGE CLARK & NORTH EASTERN MARINE (SUNDERLAND) LTD. — RICHARDSONS WESTGARTH ATOMIC LTD.

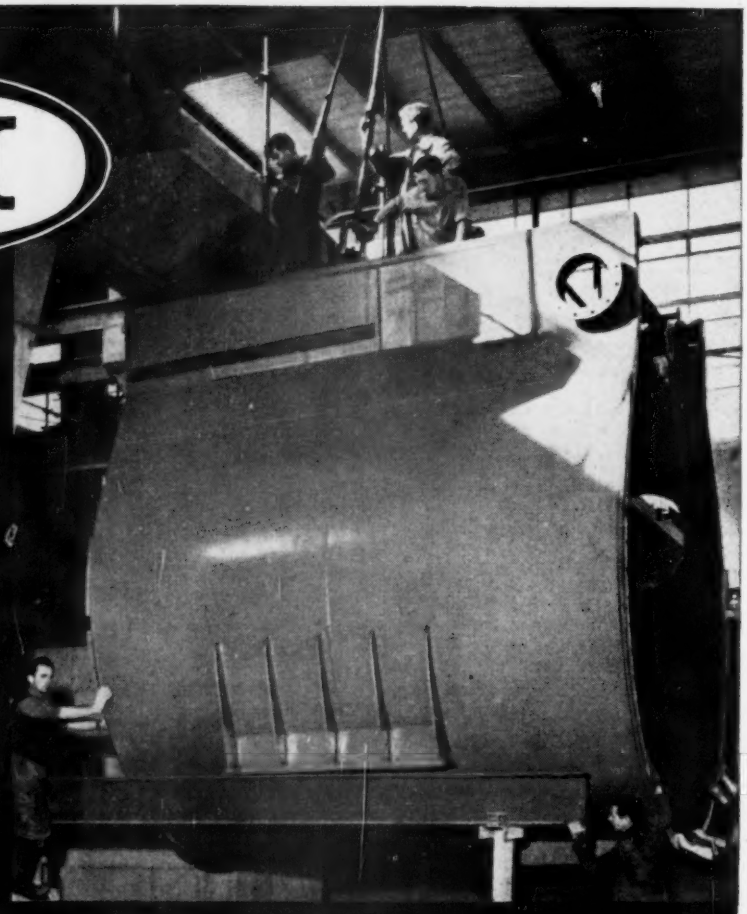
ASSOCIATED COMPANY: ATOMIC POWER CONSTRUCTIONS LTD.

RICHARDSONS WESTGARTH (Hartlepool) LTD., HARTLEPOOL, CO. DURHAM

and at 58 Victoria Street, London, S.W.1. 59 Mosley Street, Manchester, 2. 75 Buchanan Street, Glasgow, C.1

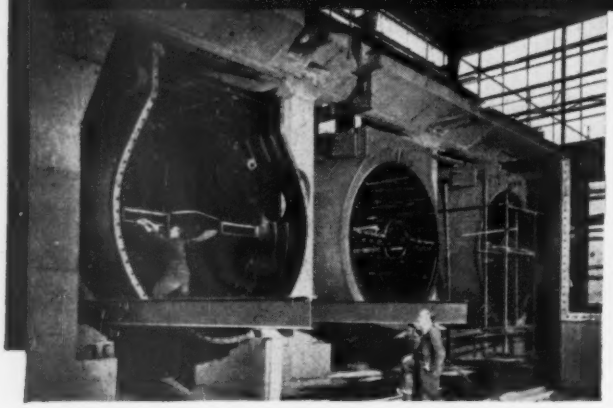
AEI

COMPLETE TURBINE-HOUSE EQUIPMENT



One unit of a three-shell surface condenser being placed in position at Berkeley, the commercial nuclear power station now under construction in Gloucestershire by the A.E.I.—John Thompson Nuclear Energy Company.

FOR BERKELEY NUCLEAR POWER STATION



A general view of three condenser shells in position at Berkeley.

The entire turbine-house heat exchange equipment for the new power station at Berkeley is being supplied by the A E I Turbine-Generator Division, and manufactured at their factory at Germiston Glasgow.

Four three-shell main condensers — one for each of the four 83 MW mixed-pressure steam turbine-generators also being supplied by A E I.

Two-stage feedwater heating equipment for each turbine-generator.

Two 'dumped' steam condensers to handle surplus steam generated when commissioning the reactors, or in the event of a sudden shut down.

Other equipment in manufacture includes the steam jet air ejectors, water/water heat exchangers for the generator cooling circuit and general gas circulator service, oil coolers and generator hydrogen cooler units.

Enquires to: AEI Turbine-Generator Division, Trafford Park, Manchester, 17

ASSOCIATED ELECTRICAL INDUSTRIES LTD.

TURBINE-GENERATOR DIVISION

WORKS AT MANCHESTER AND RUGBY, ENGLAND. GLASGOW, SCOTLAND. LARNE, NORTHERN IRELAND.

B/AE01

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

BOROUGH OF BARKING

STREET LIGHTING

TENDERS are invited for the supply, delivery and erection of:

(a) 19 No. Class "A" sodium lighting units on 25 ft concrete or steel columns in Renwick Rd, Barking.

(b) The removal of 40 No. existing steel columns (22 No. being trolley poles), and supply, delivery and erection of 45 No. Class "A" sodium lighting units on 25 ft concrete or steel columns in Fanshawe Ave and Longbridge Rd, Barking.

Specifications, Bill of Quantities and Form of Tender may be obtained from the Borough Engineer and Surveyor, Town Hall, Barking.

Sealed tenders, in the envelopes provided, must be delivered to the undersigned not later than 9 a.m. Wednesday, 13 Jan., 1960.

The Corporation do not bind themselves to accept the lowest or any tender.

E. R. FARR,
Town Clerk.

Town Hall,
Barking.
Essex. (N 475)

CITY OF MANCHESTER

DAVYHULME SEWAGE WORKS EXTENSIONS—STAGE IB

TENDERS are invited for the installation of 6,600-volt cables, road lighting and telephone cables.

Tender documents obtainable from City Surveyor, Town Hall, Manchester, returnable by 25 Jan., 1960. (N 491)

CITY OF LANCASTER

Abstraction from River Lune Scheme

PUMPING PLANT

TENDERS are invited for the SUPPLY and INSTALLATION of the following ELECTRICALLY DRIVEN CENTRIFUGAL PUMPING PLANT for dealing with water abstracted from the river:

(1) Three Low Lift Pumps—Two pumps working together to be capable of dealing with alternative flows of 3,050 g.p.m. and 4,500 g.p.m. each.

(2) Three High Lift Pumps—Two pumps working together to be capable of dealing with alternative flows of 2,778 g.p.m. and 4,167 g.p.m. each.

Conditions of Contract, Specification and Form of Tender may be obtained from the City Engineer, Town Hall, Lancaster, on payment of a deposit of £2 which will be returned on receipt of a bona-fide Tender, not subsequently withdrawn and the return of all documents supplied.

Tenders, in plain envelope, endorsed "PUMPING PLANT," to be received by the undersigned not later than 10 a.m., on Wednesday, 10 Feb., 1960.

The Corporation does not bind itself to accept the lowest or any Tender.

J. D. WADDELL,
Town Clerk.

Town Hall,
Lancaster.
31 Dec., 1959. (N 499)

WALTHAM HOLY CROSS URBAN DISTRICT COUNCIL

CLASS "A" SODIUM LIGHTING TO PART OF A112 AND CLASS "B" SODIUM LIGHTING TO PART OF MOTT STREET

TENDERS are invited for the supply, erection and wiring of 111 concrete columns to take Class "A" sodium lighting and 10 concrete columns to take Class "B" sodium lighting.

Contractors wishing to tender should send their names to the undersigned not later than noon 15 Jan., 1960.

The Council does not bind itself to accept the lowest or any tender.

H. L. MASON,
Acting Clerk of the Council.

Town Hall,
Waltham Abbey,
Essex. (N 476)

CITY AND COUNTY OF NORWICH

Improvement of Street Lighting

TRUNK ROADS: (a) A11 NEWMARKET RD. (b) THORPE RD AND MAIN TRAFFIC ROUTE, (c) HARVEY LANE

TENDERS are invited for:

1. Supply of SO/H lanterns, 62-200 watt size with control gear, 39-140 watt medium angle and 20-140 watt cut-off type.

2. Supply of control gear and lamps, 60-200 watt lamps, 59 sets of 140 watt control gear and lamps.

3. Supply of 121 tubular steel lamp columns.

4. Erection and part connection 121 columns, etc.

Tenders may be submitted for items 1, 2, 3 or 4. Copies of the tender documents may be obtained from the City Engineer, City Hall, Norwich, Norfolk, NOR 01A. Drawings may be inspected during normal working hours at the City Engineer's Office. Completed tenders are to be received not later than 10 a.m., on Friday, 22 Jan., 1960.

The Council does not bind itself to accept the lowest or any tender. (N 500)

APPOINTMENTS VACANT

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

APPLICATIONS are invited for the post of HEAD of DEPARTMENT of ELECTRICAL ENGINEERING, duties to commence 1 May, 1960.

Salary, Grade II Head of Department, £1,600 x £50—£1,800 per annum. A salary above the minimum of the scale may be paid to a suitably qualified candidate.

The department will shortly move into new premises with well equipped laboratories, workshops, etc., and there will be excellent opportunities for research and developing advanced work.

Further particulars and application form will be sent by the undersigned. Last date for the receipt of applications: 30 Jan., 1960.

E. C. SMITH,
Principal.

January, 1960. (N 527)

NEW ZEALAND MINISTRY OF WORKS ENGINEERING STAFF

THE New Zealand Ministry of Works invites applications for the following vacancies on the Permanent Staff. Positions, qualifications desired and salaries offered are as follows:

Vacancy No. 3.
MECHANICAL OR ELECTRICAL ENGINEERS

Corporate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with sufficient appropriate experience. Commencing salaries up to £1,525 p.a.

Vacancy No. 4.
BUILDING SERVICES ENGINEERS

Corporate Membership of the Institution of Heating and Ventilating Engineers, London. Commencing salaries up to £1,450 p.a.

Vacancy No. 5.
ASSISTANT MECHANICAL OR ELECTRICAL ENGINEERS

A university Degree in Mechanical Engineering or Graduate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with at least five years' experience since commencement of pupilage. Commencing salaries: £870/£1,060 p.a.

Vacancy No. 6.
ASSISTANT BUILDING SERVICES ENGINEERS

Graduate Membership of the Institution of Heating and Ventilating Engineers, London, with at least five years' experience since commencement of pupilage. Commencing salaries £870/£1,060 p.a.

Experience is necessary in the design and installation of services or equipment for one or more of the following: heating and ventilating, air conditioning, hot and cold water or sewerage services, laundries, kitchens, boiler-houses, lifts and other mechanical services in offices, schools, hospitals, hotels, telephone exchanges, printing works, defence establishments, etc. All appointees will be required to undertake work of this nature.

Applicants must be Resident in the United Kingdom or Eire and have fulfilled National Service obligations.

Enquiries, mentioning this publication and stating the Vacancy Number and the position sought, should be addressed to the High Commissioner for New Zealand, 415 Strand, London W.C.2. Full details of duties, experience required, general information on the conditions of employment in the New Zealand Public Service and application forms will then be supplied. (N 528)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Project Group

SECOND ASSISTANT ENGINEER (CIVIL)

APPLICATIONS are invited for the appointment of Second Assistant Engineer (Civil) in the Midlands Project Group.

Applicants should have had experience in the design and construction of power stations or other industrial buildings and ancillary work, together with experience in billing, measuring and estimating civil engineering and building works. They should preferably hold an appropriate qualification.

The salary will be within Grade 4, £1,195/£1,545 per annum of Schedule C of the National Joint Board Agreement.

Applications should be made on standard form AE6 available from the Administrative Officer, Midlands Project Group, 53 Wake Green Rd, Moseley, Birmingham 13, and should be returned to him not later than 11 Jan., 1960.

Envelopes should be marked "Confidential Staff Vacancy Notice No. MPG. 153/59." (N 487)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

GENERAL ASSISTANT ENGINEER (CHEMIST)
CASTLE DONINGTON POWER STATION
Vacancy No. 230/59.

Candidates must have had a sound technical training and previous laboratory experience and should preferably hold the Higher National Certificate in Chemistry, but consideration will be given to candidates studying for that qualification.

The salary will be in accordance with Schedule A of the National Joint Board Agreement and will be within the range (£560/£700 per annum).

Closing date for receipt of applications: 15 Jan., 1960.

ASSISTANT ENGINEER (INSTRUMENTS)
LEICESTER POWER STATION
Vacancy No. 231/59.

Applicants should have a good knowledge of instruments used in power stations and have had a sound technical training. Preference will be given to those possessing the H.N.C. or equivalent.

Salary will be in accordance with Class G, Grade 10 (£815/£860 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 22 Jan., 1960.

STATION SHIFT CONTROL ENGINEER
LINCOLN POWER STATION
Vacancy No. 232/59.

Applicants should have had a sound training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be advantageous.

Salary will be in accordance with Class F, Grade 10 (£765/£810 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 15 Jan., 1960.

SENIOR DRAUGHTSMAN
TRANSMISSION DEPARTMENT
DIVISIONAL HEADQUARTERS
Vacancy No. 235/59.

The work is associated with H.V. electrical substations, etc., and experience on H.V. overhead lines or underground cable systems will be an advantage, but is not essential.

Salary will be in accordance with Grade 5 (£790/£890 per annum) of Schedule D of the National Joint Board Agreement.

Closing date for receipt of applications: 22 Jan., 1960.

THIRD ASSISTANT ENGINEER
TECHNICAL DEPARTMENT
DIVISIONAL HEADQUARTERS
Vacancy No. 236/59.

Applications are invited for a position as a Test Engineer in the Divisional Technical Department at Loughborough.

The successful candidate will be primarily concerned with light current equipment and he should have a thorough knowledge of electronics principles and practice. The duties will comprise tests and investigations both in the field and in the laboratory.

Preference will be given to candidates with Higher National or Degree qualifications in Electrical Engineering.

The salary and conditions will be in accordance with Schedule B, Grade 6 (£925/£1,170 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 22 Jan., 1960.

STATION SHIFT CONTROL ENGINEER
CASTLE DONINGTON POWER STATION
Vacancy No. 237/59.

Applicants should have had a sound technical training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class L,

continued in next column

continued from previous column

Grade 10 (£1,025/£1,085 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 22 Jan., 1960.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Divisional Establishments Officer, Central Electricity Generating Board, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the dates stated.

O. S. WOODS,
Divisional Controller.
31 Dec., 1959. (N 501)

THE NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited from suitably qualified electrical engineers for the following appointments which are subject to N.J.B. Agreement for the Electricity Supply Industry:

1. Tyne Sub-Area

SENIOR ASSISTANT ENGINEER
SUB-AREA COMMERCIAL OFFICER'S DEPARTMENT
SUB-AREA HEADQUARTERS
NEWCASTLE UPON TYNE

Applicants should have wide experience of commercial practice and distribution in electricity supply, including development work in urban and rural areas.

Salary: Schedule A, Class L, Grade 4, £1,600/£1,705 per annum.

2. Wear Sub-Area

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER
SOUTH SHIELDS DISTRICT

Applicants should have experience in utilisation of electrical energy in commercial and domestic premises, knowledge of installation work and be conversant with tariffs, sales and all aspects of consumer service.

Salary: Schedule A, Class F, Grade 5, £1,025/£1,085 per annum.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne 1, within ten days of the appearance of this advertisement. (N 502)

CENTRAL ELECTRICITY GENERATING BOARD

Eastern Division

APPLICATIONS are invited for the following appointments:

GENERAL ASSISTANT ENGINEERS
RYE HOUSE GENERATING STATION

Salary: Class G, within the range of Grades 15/13, £560 x £15—£700 per annum, plus 10% Shift Allowance when required to work on shift.

The commencing salary will depend upon the duties and responsibilities.

Duties include assisting in the Electrical Control Room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc. The posts will provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a Generating Station and/or technical training to the standard of Ordinary National Certificate or its equivalent will be an advantage.

Applications, quoting reference 2/11135, stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk Lane, Cockfosters, Barnet, Herts, to arrive not later than 16 Jan., 1960.

W. N. C. CLINCH,
Controller.
(N 508)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Board Headquarters

SENIOR ASSISTANT (PERSONNEL)

Applicants should be young men of good educational background whose interests lie in industrial relations, to fill the above position. The person appointed will be given considerable scope to gain experience in the Personnel Section of the Secretary's Department where the range of functions include salary and wage negotiations, conditions of employment, personnel records, committee work and the consultative aspects affecting education, training, safety, health and welfare. The post affords an opportunity for a young man who has studied industrial relations to obtain practical experience. The conditions of the appointment will be in accordance with the National Joint Council for the Electricity Supply Industry, and the salary Grade 5, £885/£960 per annum.

Applications, by letter, giving full details of age, qualifications, experience, present position and salary should be forwarded within 14 days, to The Secretary, Midlands Electricity Board, Mucklow Hill, Halesowen, nr. Birmingham.

Central Gloucestershire Sub-Area

THIRD ASSISTANT ENGINEER (PLANNING) (HEADQUARTERS)

Duties will include assisting in the planning of 11 kV, 33 kV and 66 kV networks, preparation of technical reports, short-circuit calculations, load flows and general technical duties. Technical qualifications desirable. Salary: £965/£1,025 per annum (N.J.B. Grade K.10).

Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr S. Raybould, Sub-Area Manager, Midlands Electricity Board, Eastern Ave, Gloucester.

Shropshire and Herefordshire Sub-Area

SECOND ASSISTANT DISTRICT ENGINEER (LUDLOW)

The successful applicant will be responsible to the District Manager for the efficient operation and administration of the Church Stretton Branch. Duties will include commercial development, consumers' service and sales of appliances, domestic and commercial, and contracting in the Branch Supply Area. Duties will also involve the operation of E.H.V. and L.V. Mains and Substations within the Branch. Appropriate qualifications will be an advantage. Salary: £860/£905 per annum (N.J.B. Grade E.7). A self-contained flat is available if required.

Apply, by letter, within 14 days, stating age, experience, present salary and position, to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

F. W. CATER,
Secretary.
(N 498)

HUNTINGDONSHIRE

St. Neots Technical Institute

ASSISTANT, GRADE A

REQUIRED as soon as possible to teach Mathematics, Science and Technical Drawing, mainly with full-time first-year Craft and S.1 students. This post offers an opportunity to young engineers, with five years' experience, who wish to gain some teaching experience. Minimum qualification O.N.C. Superannuation transferable from Nationalised Industries.

Details and forms of application in connection with this post obtainable from the undersigned, to whom they should be returned as soon as possible.

I. C. CURREY,
Director of Education.
Gazeley Hse,
Huntingdon. (N 436)

Box Number replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

THE EAST MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited from suitably qualified and experienced persons for the following position:

Northamptonshire Sub-Area

Vacancy No. 127/59.

FOURTH ASSISTANT ENGINEER
(SHIFT OPERATION)

Salary: N.J.B., Class K, Grade 12 (£860 x £15—£905 per annum) plus shift allowance.

Candidates should have had experience of switching operations on a High Voltage distribution system, preferably including both Urban and Rural networks. Experience in the issue and cancellation of Permits to Work under the C.E. Safety Rules, or acting as Control Engineer for part of a High Voltage system, would be an advantage.

Applications stating age, education, experience, qualifications, present position and salary and quoting the above vacancy number, should be forwarded to the Manager, Northamptonshire Sub-Area, 25 Bridge St, Northampton, within 14 days of the date of this advertisement. (N 509)

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following position:

FOURTH ASSISTANT DISTRICT ENGINEER
SIDMOUTH BRANCH—EXETER DISTRICT

Salary according to Class G, Grade 10 (£815 x £15—£860 per annum) of the N.J.B. Agreement.

The successful candidate will be responsible for organising the installation of services and small mains extensions, and the maintenance of the Branch distribution system. He will be required to carry out Engineering Standby duties, and also to organise the Contracting activities in the Branch.

Candidates must have drive and initiative. Possession of a current driving licence is desirable.

Applications for the above post to be made on standard form AE6/ACT obtainable by postcard only from the District Manager, South Western Electricity Board, 3 Bedford St, Exeter. Closing date for receipt of completed applications is 23 Jan., 1960. (N 512)

CENTRAL ELECTRICITY GENERATING BOARD

APPLICATIONS are invited for the following posts:

FOURTH ASSISTANT ENGINEERS
(S.V. No. 1207)
SYSTEM OPERATION DEPARTMENT
THAMES NORTH GRID CONTROL
REDBOURN, NR. ST. ALBANS, HERTS

Salary: N.J.B., Class AX/EX within the range of Grade 7/8, £735 x £25—£965/£1,065 per annum.

The commencing salaries will be within the above range at a point commensurate with qualifications and experience.

Applicants should have qualifications to Higher National Certificate standard and should be prepared ultimately to undertake shift duties in the Area Grid Control Room. Some steam generating station experience is desirable.

DIVISIONAL ASSISTANT CHEMIST
(S.V. No. 1177)
GENERATION DEPARTMENT AT D.H.Q.
COCKFOSTERS, NORTH LONDON

Salary: N.J.B., Class AX/DX, Grade 6, £975 x £25—£1,100/£1,190 per annum inclusive of London Weighting.

Applicants should possess a scientific qualification not less than Higher National Certificate (Chemistry) and should have considerable knowledge of the chemical services required by a generating station. Experience of the investigation of chemical problems is desirable and the ability to prepare concise reports is necessary.

Applications, quoting the appropriate Staff Vacancy Number and reference 2/11129, stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, by the 16 Jan., 1960. (N 488)

LONDON COUNTY COUNCIL

S.E. London Technical College

GRADE B LECTURER IN ELECTRICAL ENGINEERING

REQUIRED to teach up to I.E.E. Part III standard. Facilities for approved research, if desired.

Salary within the range £738/£1,486. Commencing salary and maximum according to age, qualifications and experience.

Application forms from Secretary at College, Lewisham Way, S.E.4, returnable within two weeks of advert. date. (2785.) (N 530)

YORKSHIRE ELECTRICITY BOARD

ASSISTANT CHIEF ACCOUNTANT

APPLICATIONS are invited from qualified accountants for the position of an Assistant Chief Accountant at the Head Office of the Board. Candidates should have had wide experience of the financial and accountancy work of public utility undertakings.

The salary will be in accordance with the N.J.M. Class C, Grade 7 (£2,360/£2,560) and the post is superannuable.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Secretary, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, Nr. Leeds, not later than 22 Jan., 1960.

No. 6 (Hull) Sub-Area

SECOND ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)

Applicants should have experience in the operation and maintenance of equipment at voltages up to 66 kV on both underground and overhead systems.

Corporate Membership of the Institution of Electrical Engineers or equivalent qualification is desirable.

The successful applicant will be required to assist in all matters affecting the operation and maintenance of the Sub-Area network.

Salary: N.J.B., Class L, Grade 7 (£1,270 x £30—£1,360 per annum).

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 6 (Hull) Sub-Area, Yorkshire Electricity Board, Ferensway, Hull, not later than 22 Jan., 1960.

No. 3 (Sheffield) Sub-Area

ROTHERHAM/MEXBOROUGH DISTRICT
INSTALLATION ENGINEER

Applicants should have served an apprenticeship and have been technically trained in Electrical Contracting work, including tendering; preparation of specifications and in the organisation and supervision of a large manual staff will be an advantage.

Salary: N.J.B., Class K, Grade 8 (£1,095 x £25—£1,170 per annum).

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 22 Jan., 1960.

No. 1 (Bradford) Sub-Area

FOURTH ASSISTANT ENGINEER
(METERS, TESTING AND PROTECTION)

Candidates should hold the Higher National Certificate in Electrical Engineering or an equivalent technical qualification. They must have had a sound training on metering, recording and indicating instruments and protective relays of all types. A knowledge of power transformer testing and general testing of instruments and relays in substations would be an advantage.

Salary: N.J.B., Class K, Grade 13 (£815 x £15—£860 per annum).

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45/53 Sunbridge Rd, Bradford, not later than 22 Jan., 1960. (N515)

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Division

Vacancies in

Transmission Construction Section

No. 93B/9

THIRD ASSISTANT ENGINEER

DIVISIONAL HEADQUARTERS, KINGSTON

REQUIRED to specify in detail equipment required for all types of transmission contracts; supervise the preparation of necessary layout drawings and schematic diagrams; conduct technical correspondence with contractors, etc. Candidates must be suitably qualified and experienced and have a thorough knowledge of contract procedure and conditions. Salary within range £975/£1,190 per annum, including London Allowance.

No. 237/9

THIRD OR FOURTH ASSISTANT ENGINEER
NORTHFLEET TRANSMISSION DISTRICT

Required to assist in office and site work concerning the construction of overhead lines, switchgear and transformers on the grid system. Candidates should possess at least H.N.C. (Electrical or Mechanical). Salary within range £890/£1,190, including London Allowance.

Superannuation and sick pay schemes in operation.

Applications, giving all relevant details and quoting vacancy number, to Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames.

Closing date: 25 Jan., 1960. (N 507)

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)
(Z.1024)

SWINDON District of No. 2 (Newbury) Sub-Area. Salary: N.J.B., Class F, Grade 10 (£765 x £15—£810 per annum). N.J.B. conditions of service.

The duties of the post will be to assist with the maintenance and operation of H.V. and L.V. distribution mains and substations and with minor construction work. A technical training to H.N.C. standard and experience of similar work are required.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him quoting Z.1024 not later than 18 Jan., 1960.

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)
(Z.1147)

Salisbury District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B., Class F, Grade 11 (£710 x £15—£755 per annum). N.J.B. conditions of service.

The duties of the post will be to assist with the maintenance and operation of H.V. and L.V. distribution mains and substations and with minor construction work. Applicants should have had sound experience in electricity supply distribution and the possession of suitable technical qualifications would be an advantage.

GENERAL ASSISTANT ENGINEER
(Z.1145)

Southampton District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B., Class G, Grade 11 (£765 x £15—£810 per annum). N.J.B. conditions of service.

The duties of the post will be to assist with the preparation of schemes and estimates for extensions of and reinforcement to overhead and underground H.V. and L.V. networks. Applicants should have had sound experience in electricity supply distribution and the possession of suitable technical qualifications would be an advantage. The appointment will involve standby duties.

Applications for the last two appointments on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting the appropriate "Z" number, not later than 18 Jan., 1960.

The successful candidates for all three appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (N 514)

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

AREA ENGINEER (TOBAGO)

AN Area Engineer is required by the Trinidad and Tobago Electricity Commission for their Tobago Branch. The annual salary is £1,402 10s rising to £1,477 10s. A car allowance is also paid and an interest-free loan advanced for the purchase of a motor car. A flat furnished with heavy furniture will be provided at a rental of £3 2s 6d a month. An outfit allowance of £60 is paid on arrival in Trinidad. There is a Superannuation Scheme similar to that existing in the Electricity Supply Industry in the United Kingdom. First Class passages to Trinidad will be provided for the successful applicant, his wife and children up to a maximum cost of four adult passages. Leave passages to the United Kingdom will be provided after three years' service.

The minimum qualification required from applicants is a Higher National Certificate in either Electrical or Mechanical Engineering or First Engineer's M.O.T. Diesel and Steam Certificate or Qualified Chief E.R.A. in the R.N. Candidates must have experience of Diesel Plant.

Information on Trinidad can be obtained from the West India Committee, 40 Norfolk St, London W.C.2.

Applications giving full details of qualifications, age, experience, etc., together with copies of two recent testimonials should be sent by Air Mail to reach the General Manager, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, W.I. by 28 Feb., 1960. (N 513)

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

APPLICATIONS are invited for full-time posts in the Department of Electrical Engineering, duties to commence from dates to be arranged.

The salary of the posts will be dependent upon the qualifications and experience of the persons appointed and will be in accordance with one of the following scales:

SENIOR LECTURER

£1,550 by £50 to £1,750 per annum.

LECTURER

£1,370 by £35 (4) and by £40 to £1,550 per annum; or

ASSISTANT GRADE "B"

£700 by £27 10s (16) and by £37 10s to £1,150 per annum.

The Department will shortly move into new premises and will be provided with new equipment and excellent facilities for research and advanced work. Candidates should be University Graduates with industrial or teaching experience. Corporate membership of the Institution of Electrical Engineers is also desirable.

Further particulars and application forms will be sent by the undersigned. Last date for the receipt of applications: 30 Jan., 1960.

E. C. SMITH,
Principal.

January, 1960. (N 526)

CITY OF SHEFFIELD

APPOINTMENT OF PUBLIC LIGHTING ENGINEER

APPLICATIONS are invited from persons possessing necessary qualifications and experience for appointment to the post of Public Lighting Engineer on Scale B of J.N.C. for Chief Officers—commencing salary £1,315 rising by annual increments (one of £60, two of £55 and one of £45) to £1,530 per annum. Wide knowledge of street lighting, both gas and electricity, is essential.

The appointment is a whole-time one, superannuable, and subject to medical examination.

Applications on the official form, to be obtained from me, must be addressed to and received by me not later than the 30 Jan., 1960.

Canvassing, direct or indirect, will disqualify.

JOHN HEYS,
Town Clerk.

Town Hall,
Sheffield 1. (N 535)

THE SOUTH WALES ELECTRICITY BOARD

DISTRICT ENGINEER

APPLICATIONS are invited for the position of District Engineer in the Cardiff District of the Cardiff and East Central Area of the Board.

The salary for the position will be in accordance with Class H, Grade 2 (£1,470/£1,575) of the National Joint Board Agreement for the Electricity Supply Industry. At the present rate of progress there are prospects that the classification of this District will be Class J in the not too distant future.

Applicants should be Chartered Electrical Engineers with experience in large Districts combining industrial, domestic and commercial loads on overhead and underground networks. They should be familiar with the problems of extensive reinforcement, planning and voltage standardisation and should be experienced in the control of all classes of labour.

Applications stating age, present position, present salary, qualifications and experience should be addressed to C. L. Townsend, ASSOC.I.E.E., Manager, Cardiff and East Central Area, South Wales Electricity Board, 445/447 Cowbridge Road East, Cardiff, so as to reach him not later than Saturday, 23 Jan., 1960. (N 494)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Dundee Area

THIRD ASSISTANT ENGINEER (CONSTRUCTION)

APPLICATIONS are invited for the above-mentioned position.

Applicants should have a good general experience in all types of substation construction work. Duties will include maintenance of 33 kV and 132 kV oil circuit-breakers, on load tap changing equipment and ancillary gear, also installation of multi-core control cables, lighting and heating circuits in major substations and supervision of 33/11 kV substation construction.

The minimum educational qualification is the Higher National Certificate in Electrical Engineering and preference will be given to applicants who are members of the Institution of Electrical Engineers or who have qualifications leading to membership.

Salary: £910/£955 per annum (N.J.B., Class H, Grade 9).

Application forms are obtainable from the Area Manager, 7 Dudhope Crescent Rd, Dundee, and should be returned by the 25 Jan., 1960. (N 510)

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ASSISTANT
DOVER DISTRICT

SALARY: £640/£700 p.a. under N.J.C., Grade 2. Superannuable. The person appointed must be fully experienced in modern installation practice and be able to prepare competitive quotations for both large and small installations. He must be conversant with the preparation of heating schemes and also water heating installations. A knowledge of appliances is also essential.

Applications, quoting ET and naming two referees, to District Manager, Seeboard, Ladywell, Dover, by 20 Jan., 1960.

ASSISTANT DISTRICT ENGINEER
BRIGHTON AND HOVE DISTRICT

Salary: £860 x £15—£905 p.a. under N.J.B. Class H, Grade 10. Superannuable. Applicants should possess the H.N.C. in electrical engineering or its equivalent and have had training and experience in the construction, operation and maintenance of underground distribution systems up to 33 kV. Knowledge of d.c./a.c. changeover will be an advantage.

Applications, quoting ET and naming two referees, to District Manager, Seeboard, Electric Hse, Castle Sq, Brighton, by 20 Jan., 1960.

GEORGE WRAY,
Secretary.
(N 517)

CENTRAL ELECTRICITY GENERATING BOARD

North Eastern and Yorkshire Region

MECHANICAL ENGINEER

APPLICATIONS are invited for the appointment of Mechanical Engineer in the Regional Research and Development Department with Headquarters in Leeds. The successful candidate, who will be responsible to the Regional Research and Development Officer, will be expected to co-operate with other sections in the Research Department dealing with Physics, Chemistry, Metallurgy and Electrical Engineering, and with other Engineering Departments engaged on operational work within the Region.

The duties will include the initiation, assessment and direction of various research and development projects associated with steam condensers, heat exchangers, pumps and design of large scale test rigs.

Candidates should have an honours degree in engineering or equivalent qualification and, preferably, some research and development experience.

The salary for the appointment, which is superannuable, will be in accordance with N.J.B. Agreement, Schedule B, Grade 2 or 3 (£1,365/£1,740) and will commence at a point commensurate with qualifications and experience.

Forms of application may be obtained from the Assistant Regional Secretary (Personnel), North Eastern and Yorkshire Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 29 Jan., 1960. Envelopes to be endorsed "Confidential" quoting SVN1/60. (N 511)

ELECTRICAL RESEARCH ASSOCIATION

GRADUATE with good degree in Electrical Engineering or Physics required in Section dealing with problems concerning Applications of Electricity in HORTICULTURE.

Salary within range £700/£900 according to qualifications. Superannuation under F.S.S.U.

Applications to Head of Rural Electrification Dept., E.R.A. Field Station, Shinfield, Nr. Reading, Berkshire. (N 529)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

GENERAL ASSISTANT ENGINEER (EFFICIENCY)

REQUIRED at Castle Meads Power Station, Gloucester.

Superannuation Scheme. Salary: N.J.B., Class E, Grade 11, £655/£700. Duties will be of a general engineering nature in connection with efficiency, instrumentation and technical records. Applicants should preferably possess a Higher National Certificate. Previous applicants need not re-apply.

Applications on Form AE6/ACT, obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 15 Jan., 1960. (N 516)

DRAUGHTSMEN required for Consulting Engineers' Office, to assist in the design of lighting and power installations for all classes of buildings. Five-day week. Spring and summer holidays. Pension scheme and luncheon vouchers. Apply in writing, stating age, experience, present salary and salary required to: J. Roger Preston and Partners, 15 North Audley St, W.1. (N 521)

ELECTRICAL SALES ENGINEER

Bruce Peebles and Co. Ltd., East Pilton, Edinburgh 5, require an Engineer of H.N.C. standard for their Transformer Sales Department. Five-day week; staff pension and bonus schemes. Housing assistance if necessary. Apply, giving details of experience, to Divisional Director (Transformers), at the above address.

(N 412)

CENTRAL ELECTRICITY GENERATING BOARD

HEADQUARTERS DRAWING OFFICE

Applications are invited for the following appointments at Bankside House, Sumner St, S.E.1:

A. SENIOR DRAUGHTSMEN—CIVIL, for R.C. foundations and light structures. Salary scale: £830/£940 p.a.

B. SENIOR DRAUGHTSMEN—ELECTRICAL, for work on 132 kV layout or diagrams, and/or with industrial heating and lighting experience. Salary scale: £830/£940 p.a.

C. DRAUGHTSMEN—CIVIL, for R.C. detailing. Salary scale: £660/£780 p.a.

D. ILLUSTRATIVE DRAUGHTSMAN—experienced on catalogue and illustrative work. Salary within the range £565/£740 p.a.

Permanent pensionable appointments. Staff restaurant. Sports and social club.

Applications in writing to, or application forms can be obtained from, the Personnel Officer, 24/30 Holborn, London E.C.1. Envelopes should be marked "Confidential Ref. ET/490."

(N 489)

ELECTRICAL MAINTENANCE SUPERVISORS

are required at

CALDER WORKS NUCLEAR POWER STATION

to be responsible for maintenance work on all sections of electrical equipment. Shift working will be involved as well as responsibility for certain aspects of shift maintenance.

Applicants must have served a recognised engineering apprenticeship and be experienced in the control of staff engaged on the maintenance of heavy electrical equipment. They should have a good knowledge of high and low voltage switchgear, large D.C. and A.C. rotating machines, and associated control gear. Possession of an O.N.C. may be an advantage.

Salary scale: £925 (at age 30) to £1,165 p.a.

Contributory Superannuation.

Staff Housing Scheme.

Send postcard for application form, quoting reference P./W.8/J8. to Recruitment Officer, Windscale Works, Sellafield, Seascale, Cumberland.

Closing date: 1 Feb., 1960.

(N 495)

ELECTRICAL ENGINEER required by BRITISH PETROLEUM CO. LTD. for service in the PERSIAN GULF on off-shore drilling project. Applicants, aged 28-35, must hold an H.N.C. at least and should have experience in the installation, operation and maintenance of small power systems and associated switchgear and transformers with overhead and underground transmission up to a maximum of 3·3 kV. Experience with diesel alternator maintenance an advantage. As no married accommodation, bachelors preferred, though fortnight's leave every four months permits free travel to the U.K. periodically. Attractive salary plus generous allowance, free passage out and home. Free medical attention. Kit allowance. Write giving full particulars, quoting F.583, to Box 3222, c/o 191, Gresham Hse, E.C.2. (N 531)

ELECTRICAL ENGINEER required by London Consulting Engineers for preparation of design, specifications, etc., for schools, hospitals and commercial buildings. Write stating age, experience, qualifications and salary required to Box No. 7393, Electrical Times. (N 18)

EXPERIENCED STAFF FOREMAN required for London Electrical Contractor, capable of supervising various types of contracts. Ability to drive and experience of estimating an advantage, but not essential. Please reply to Box No. 7647, Electrical Times. (N 536)

ELECTRICIANS

Electricians required for general maintenance and installation work on large integrated Iron and Steel Works. Excellent conditions. Pension Scheme in operation. Apply to: **The Employment Officer, Appleby-Frodingham Steel Co., Scunthorpe, Lincs.**

(N 523)

ELECTRICAL ENGINEERS required for Consulting Engineers' Office, to carry out the design of lighting and power installations for all classes of buildings. Five-day week. Spring and summer holidays. Pension scheme and luncheon vouchers. Apply in writing, stating age, experience, present salary and salary required, to J. Roger Preston and Partners, 15 North Audley St, W.1. (N 522)

SALES REPRESENTATIVE

Johnson and Phillips Ltd. wish to engage a suitably experienced Sales Representative for their Bristol Branch primarily for the sale of electric cables in the West Country.

Applications giving full details of experience to: Employment Manager, Johnson and Phillips Ltd., Victoria Way, Charlton, London S.E.7.

(N 504)

ELECTRICAL Contractors, Victoria area, require GENERAL CLERK for invoices, time sheet analysis and wages. Write, stating age, experience and salary required, to Box 7643, Electrical Times. (N 533)

m and i — *the Electrical Insulation People*

have a vacancy for a

TECHNICAL ASSISTANT

The appointment is in a small department responsible for the investigation and development of new processing methods covering a wide field of materials related to the manufacture of electrical insulation products.

The nature of the work involves close liaison with Research and Development Laboratories, Plant Design and Works Production Departments.

Applicants should possess a minimum qualification of O.N.C. in Electrical Engineering or Physics or Chemistry and should have had some experience in the electrical engineering industry.

As the leading manufacturer of insulation products, and a member of the A.E.I. Group, the Company is closely connected with many important developments in the electrical industry and offers excellent career opportunities.

Detailed applications are welcomed and should be sent to:

The Personnel Manager,

THE MICANITE & INSULATORS CO. LTD.

Blackhorse Lane, Walthamstow, London, E.17

(N 490)

BRITISH Enka LIMITED

ENGINEERING DIVISION CONCERNED WITH MAN MADE FIBRES AND FILMS

have vacancies for

SENIOR & JUNIOR DRAUGHTSMEN

in the following departments:—

MECHANICAL, BUILDING, ELECTRICAL

Experience in any of the above is essential and Chemical Works' experience would be an advantage. The work involved is of a varied and interesting nature. Salaries up to £1,000 according to age and experience. Contributory Pension Scheme with facilities for transfer. Five-day week. Applications giving full details of qualifications and experience to:

Personnel Manager,

BRITISH ENKA LTD., AINTREE, LIVERPOOL, 9.

(N 518)

RAILWAY ELECTRIFICATION

Assistant Foreman — Class II Required

Railway Male Supervisory Conditions of Service

Salary range: £637/£672.

Experience in erection, repair and maintenance of overhead Line Contact systems. Should possess sound knowledge of safety precautions, electrical, mechanical and personnel.

Successful applicant will be temporarily located at Romford, Essex, but will be required to work in any section of the Eastern Region Electrification.

Apply to:

Electric Traction Engineer,
British Railways
Eastern Region,
Ley St, Ilford, Essex.

(N 462)

ELECTRICAL DRAUGHTSMAN required by Engineers in South London, O.N.C. or City and Guilds standard preferred, but not essential, experienced lighting and power layouts; top salary; five-day week; permanent post. Excellent opportunity for a keen man. Write giving age and experience to Box No. 7637, Electrical Times. N 505)

A MAN WITH AN ENGINEERING BACKGROUND, having a knowledge of design, sketching and drawing, required by well-known Steel Company. Some commercial experience would be an advantage. The successful applicant will work in the Market Research and Development office of the Company in London. His duties will be varied and interesting; salary will be according to experience and qualifications. Applications giving brief description of experience, age, etc., to Box No. 7641, Electrical Times. (N 532)

ENGINEERING Trade Association at Ascot, Berks, requires an ASSISTANT with practical training in electrical engineering. Applicants should have experience in estimating for power transformers. Age 25/35. Salary paid will be commensurate with age, experience and qualifications. Pension Scheme. Full applications to Box No. 7629, Electrical Times. (N 407)

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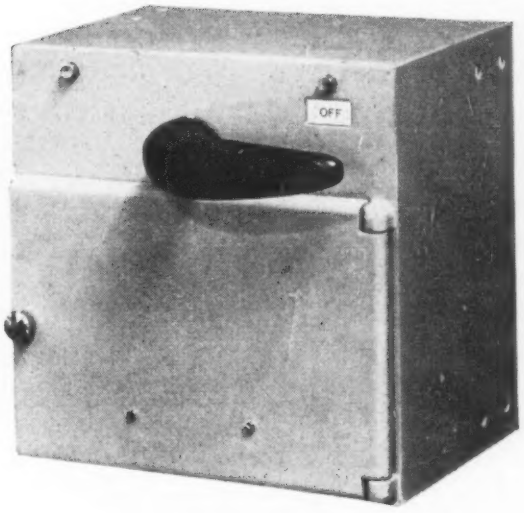

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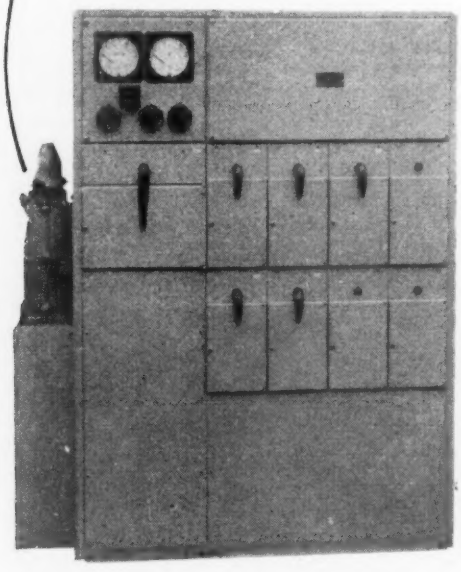

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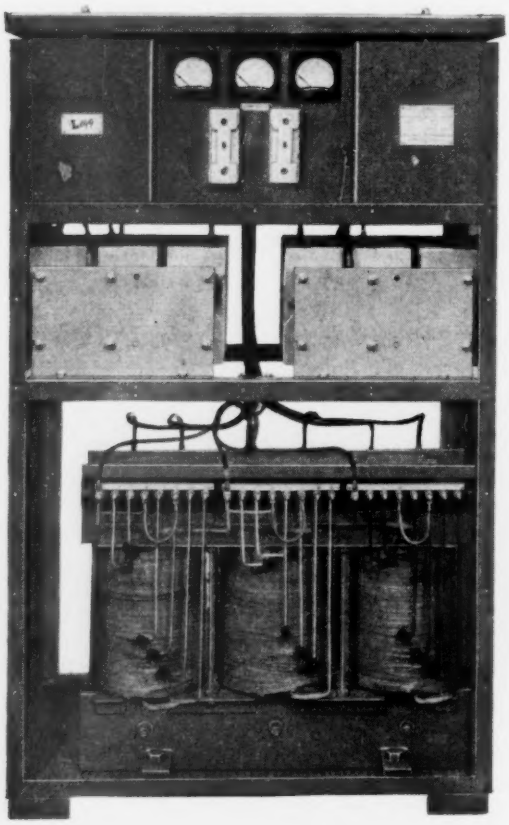

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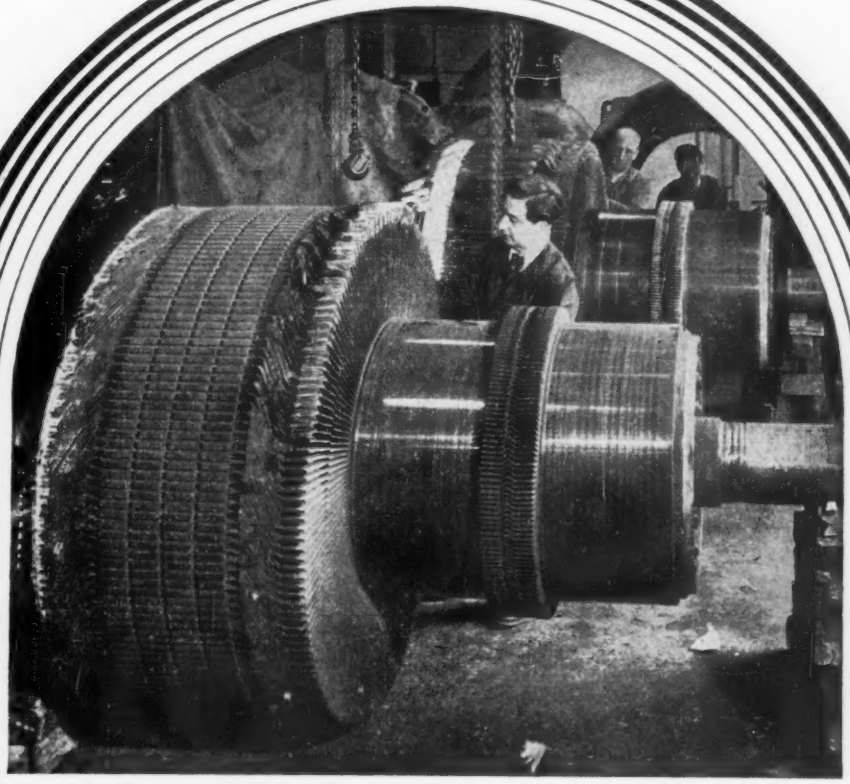

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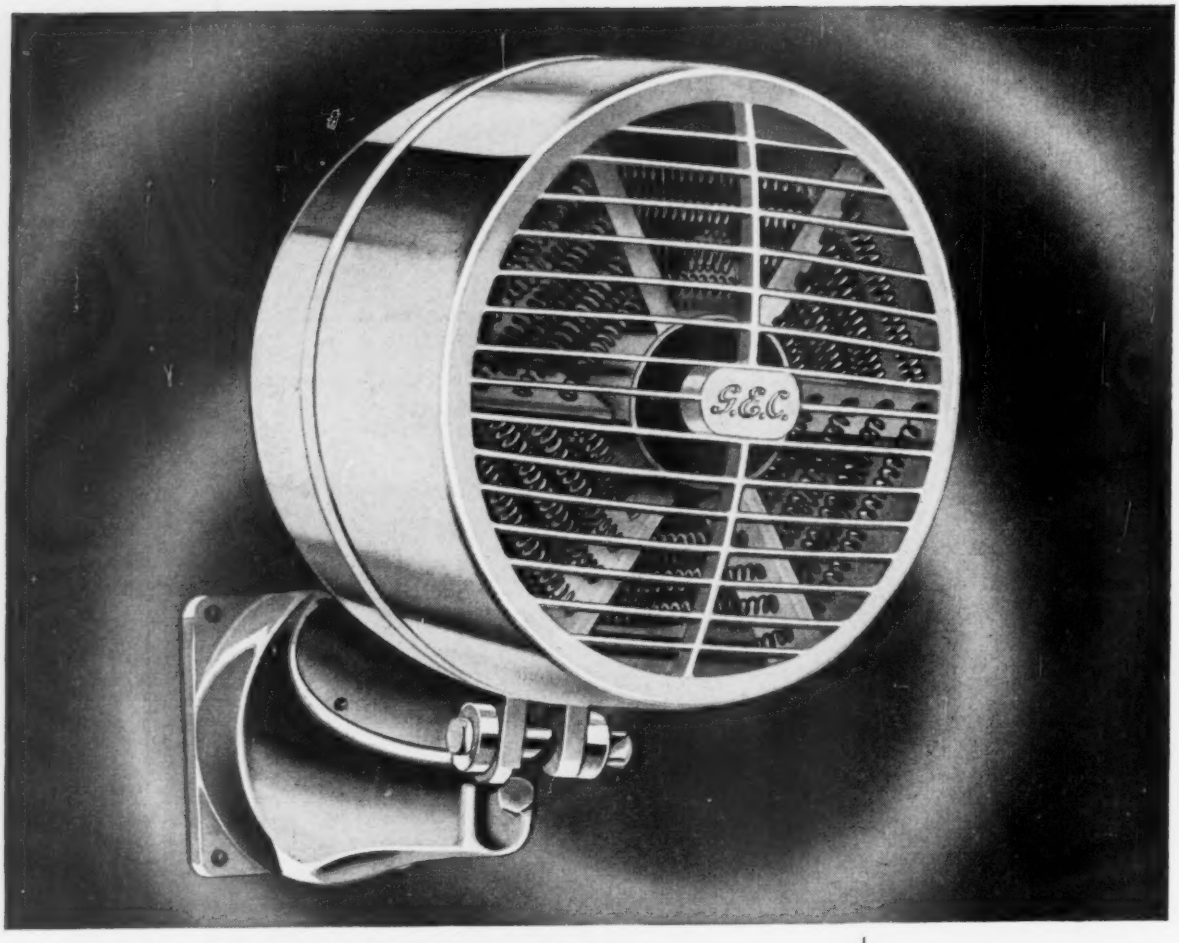

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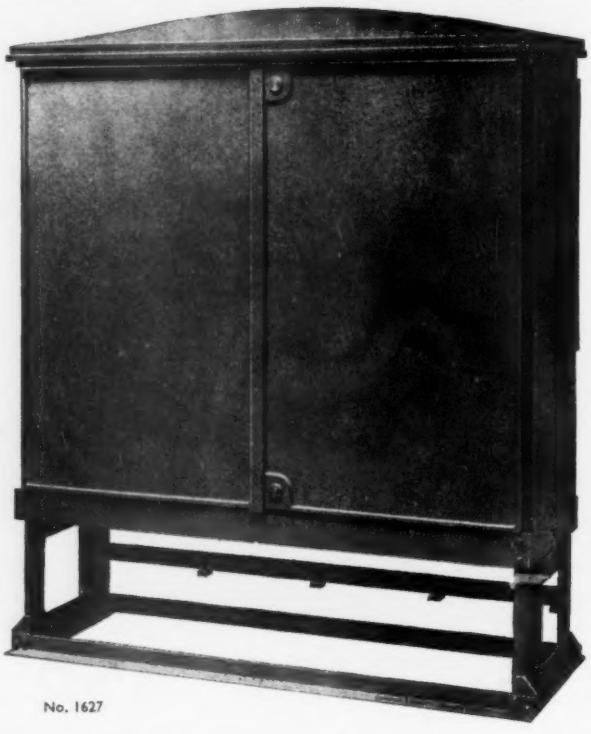

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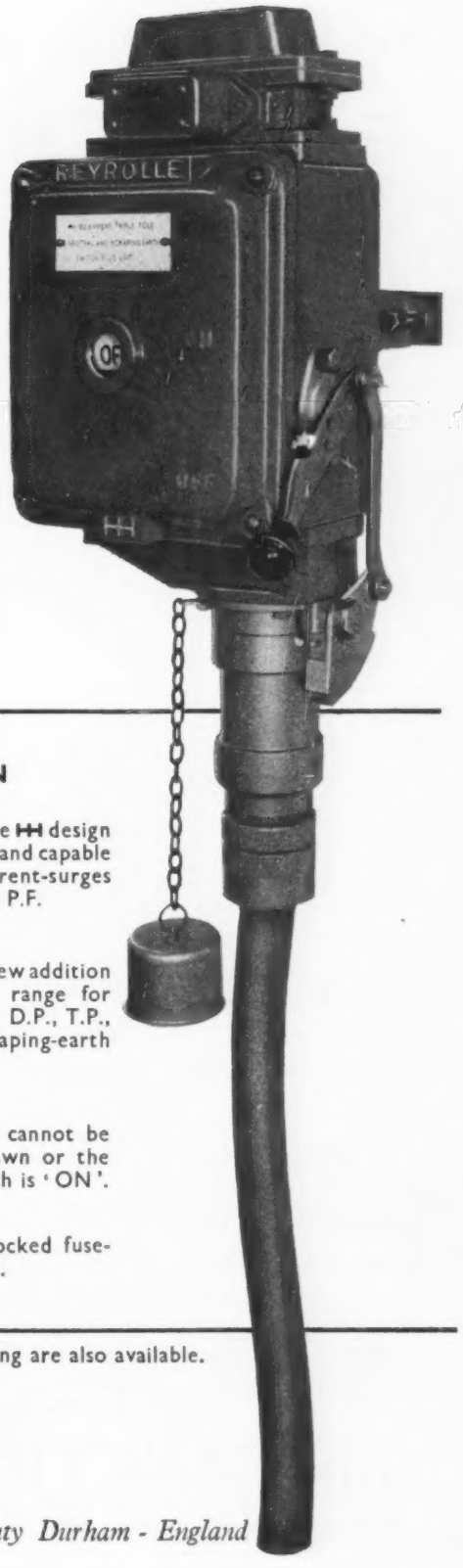

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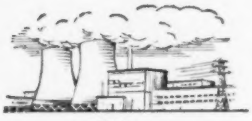

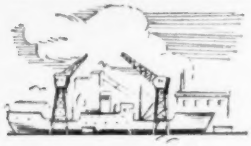

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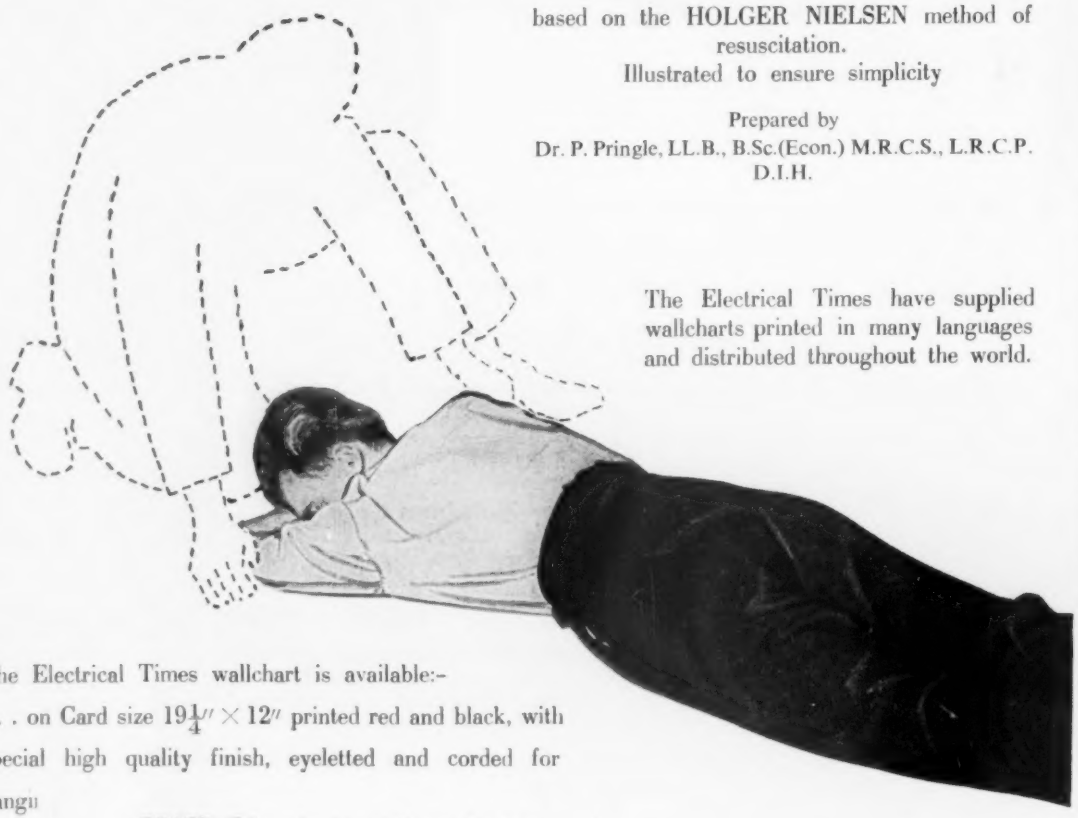

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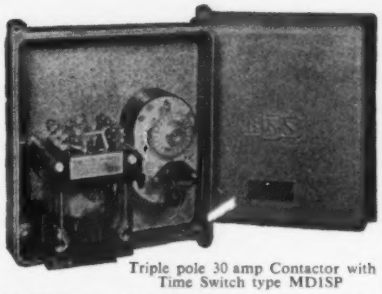

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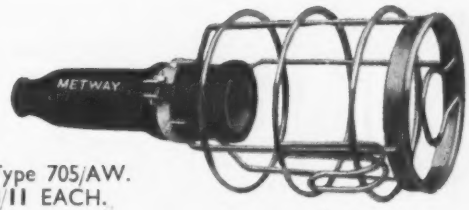

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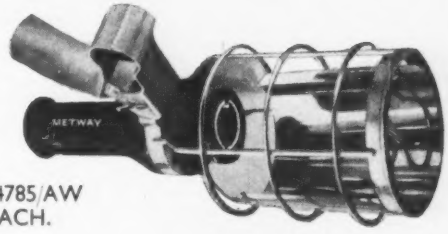

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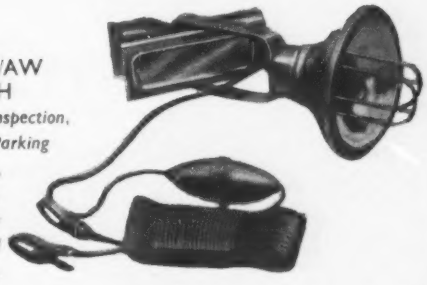

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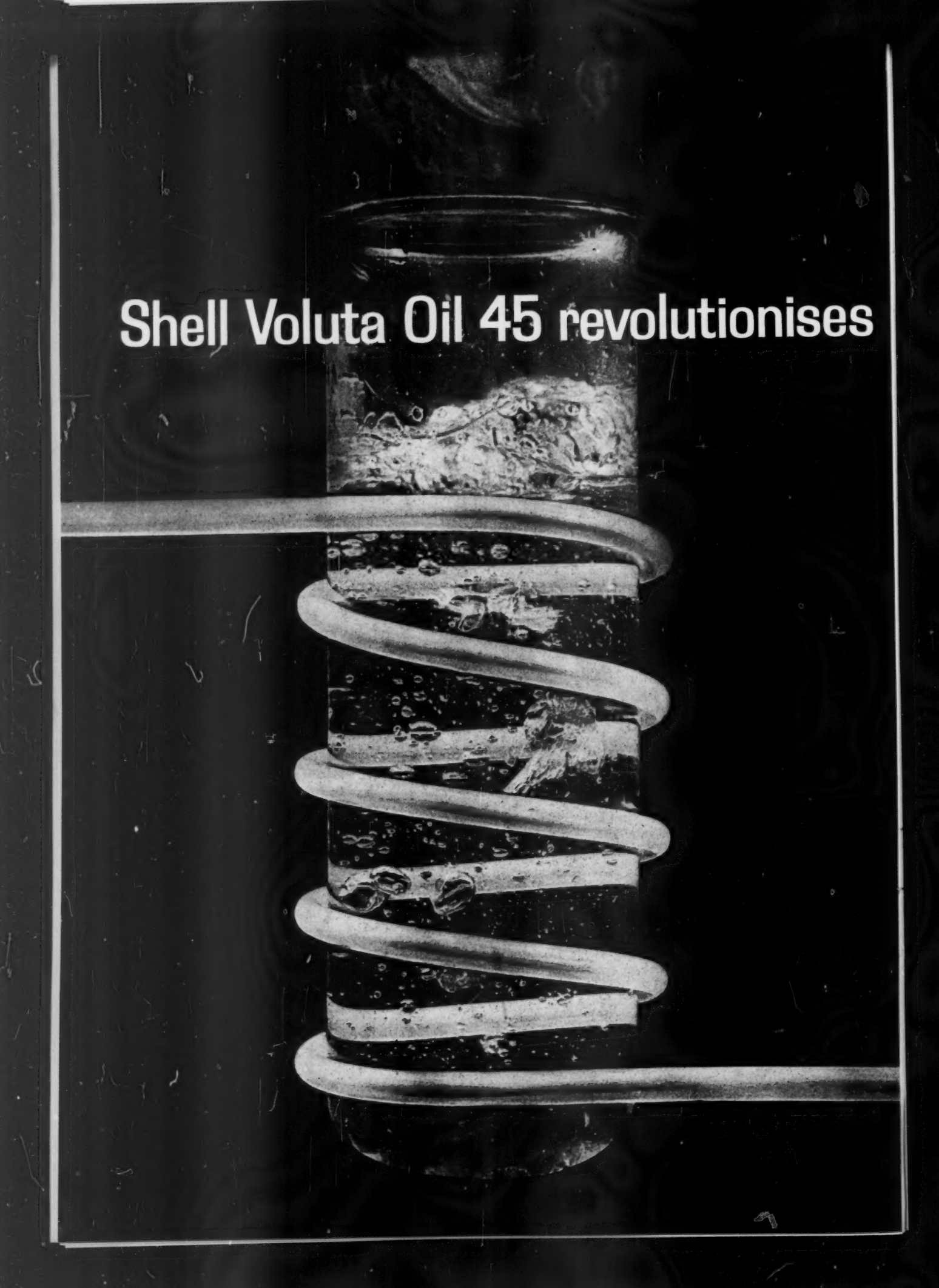
For Car inspection, Campers, Parking Light, etc., with 13 ft. flex, battery clips and spring grip.

● Export—"Gripway" Handlamps are available with E.S. Lampholders

For Details and Discounts write for Brochure 1160 ET

METWAY • KEMP TOWN • BRIGHTON

VISIT US N.12, A.S.E.E. EXHIBITION, EARLS COURT, 5—9 April, 1960


Shell Voluta Oil 45 revolutionises

heat exchange practice

Before Shell produced Voluta Oil 45 it was thought that oils which were to be used for heat exchange purposes must have a high flashpoint —to reduce fire risk, and a high viscosity—to prevent excessive leakage through pump glands and to provide adequate lubrication for pump bearings at high temperatures. Heat exchange systems containing these viscous oils, however, were sluggish, particularly when started up from cold. The oil circulated slowly over the source of heat and suffered thermal decomposition, or "cracking". This, in turn, produced low flashpoint materials and carbon which insulated the heating surface.

Shell, therefore, began investigating the suitability of oils of lower viscosity and different chemical constitution. From this research was developed Shell Voluta 45.

Shell Voluta 45 contains hydrocarbons with a saturated ring structure which does not have the tendency that high viscosity straight chain paraffin hydrocarbons had—to break down at high temperatures. Because of its low viscosity Shell Voluta 45 heats up more quickly from cold and circulates more rapidly thus avoiding local overheating and thermal decomposition.

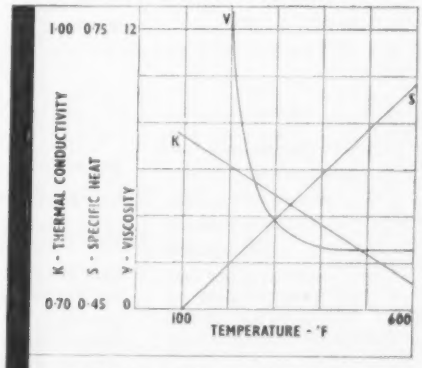
Shell Voluta Oil 45 has excellent heat transfer properties, good thermal stability and good lubricating properties. It is recommended for use in all closed heat transfer systems.

The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organisation have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Laboratory research to compare the high temperature performance of various oils in a rig simulating practical conditions showed that when oils of varying viscosities were maintained at an average temperature of 325°C. for 200 hours, the closed flashpoint of the high viscosity oils had dropped to a lower figure than that of oils of lower viscosity, indicating that some thermal decomposition had taken place.

Experimental oils were subjected to Heat Stability Tests and to tests designed to measure the variation in heat transfer coefficient with time. The most promising of these oils was then given extensive field trials, both in Shell Installations and in industry. From this extensive research was developed Shell Voluta 45.



Physical properties of Shell Voluta Oil 45.
K. Thermal Conductivity—B.T.U./sq. ft. per hour per 1°F. per inch.
S. Specific Heat—B.T.U. per lb. per 1°F.
V. Viscosity—Kinematic centistokes.

SHELL

HEAT TRANSFER OILS

another proof of Shell leadership in lubrication

G.E.C. Magnet frame for 4,000 h.p. Mill Motor treated with P.J. Black Sealing and Finishing Varnish
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Additions are continually made to our range of specialised insulating varnishes and electrical machinery finishes. Recent research has largely been concerned with exploiting the latest synthetic resins, and many new formulations with characteristics of considerable interest to the electrical industry have been evolved in our laboratories.
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COPPER WIRE ENAMELS
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ACID AND HEAT RESISTING ENAMELS
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(Black, Clear and Colours)
CABLE LACQUERS
(Non-flam., Cellulose Type and P.V.C.)
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(Various Types)

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ALL FORMS OF MICANITE
INCLUDING SILICONE BONDED CLASS "H" INSULATION WITH OR WITHOUT GLASS CLOTH

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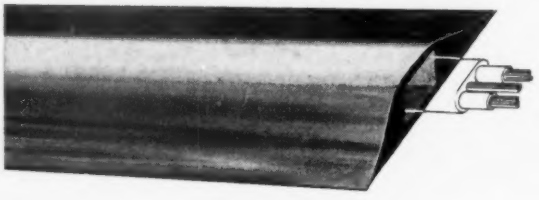
PRESTON · ENGLAND

VULCASCOT RUBBER CONDUIT STRIP

protects loose leads
Registered Design 692356



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Light vehicles can safely cross
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Larger sections available for Welding-cables, Trailer-cables, etc.
We specialise in rubber and plastic strip, cord, channelling, tubing—long and short runs—for all purposes to any design.

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AEI CABLES

As from 1st January 1960

the cable interests of

W. T. Henley's Telegraph Works Co. Ltd.

Liverpool Electric Cable Co. Ltd.

Siemens Edison Swan Ltd.

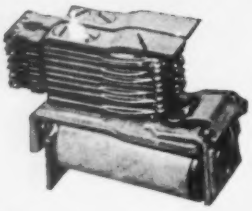
have been merged into

Associated Electrical Industries Limited
CABLE DIVISION

51-53 Hatton Garden London E.C.1

RELAYS OF RELIABILITY

EG PRODUCTS



MINIATURE TELEPHONE RELAY OPEN TYPE

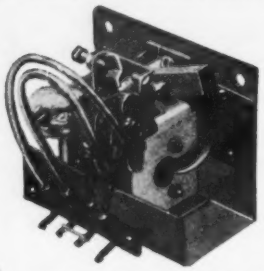
Designed to meet modern requirements for a small yet highly efficient relay for the aircraft and allied industries. Standard model, available in a variety of contact combinations, comparable to P.O. type 3000 and 600 range relays. Features: High immunity to shock and vibration, small and light, ease of installation, long life. Standard voltages, 6, 12, 24 & 48 V.D.C. Physical dimensions:—Height 1.77" 6 pole, depth 1.81", width 0.71", weight 78 grams. Contact rating 1 amp 250 V.

SEALED MINIATURE TELEPHONE RELAY

Hermetically sealed with metal base, stud connections are brought out via glass compression seals and has an exceptionally high insulation resistance. 14 connection pins are at present available and any contact combination required to this number can be supplied. Overall dimensions:—height 1.23/32", depth 2.9/16", width 31/32".

PLUG-IN RELAY

First introduced in 1948 for use in Electronic Circuits where space is limited and heavy duty contacts are required.
Operates on A.C. or D.C. both versions being silent in operation, plug-in international octal base pattern mounting. D.P. Changeover Contacts rated at 3 amps are fitted as standard, special impulse type contact or hermetically sealed versions are also available.



'H' SERIES RELAY PANEL MOUNTING TYPE

A smaller version of the well-known Mk II relay is available with contact arrangements from 3 amp T.P. to 30 amp S.P.
Special features are:—
Silent operation, Mercury Switch Contacts requiring no servicing, Small size, Low operating power.
Competitive price.
Operates on A.C. or D.C.
Overall dimensions open type 3.3/16" x 3" x 2.1/4".

STOP PRESS Ex Stock. Standard types of Mercury Relays and Contactors with Current Ratings from 5 to 60 A. Single, Double and Triple pole available.

ENGLE & GIBBS LTD

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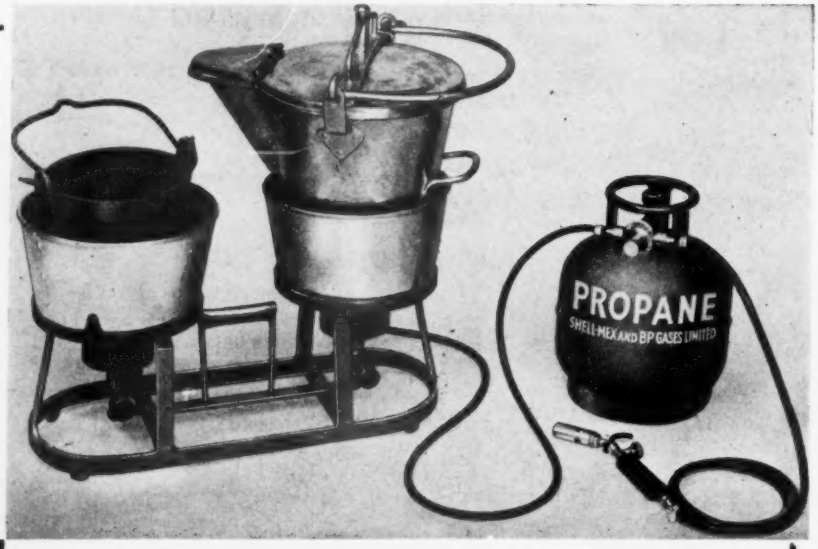
Telephone: ELSTREE 2291/2/3/4

specify Sheen cable jointing equipment



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This meets all the requirements of Local Authorities and Main Contractors. Of sound design and robust construction — it is manufactured by a Firm with many years experience in this type of equipment. *We recommend Propane as supplied by Shell-Mex and B.P. Gases Limited for use with all our equipment.*

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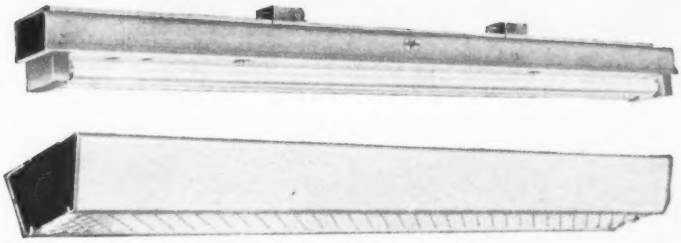

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The varying lighting needs of office, works or showrooms *need not now* involve any extra expense on different fittings, special installations or complex maintenance. With only the one basic fitting of **atlas atlantic** you can achieve the right light for every department, by a simple interchange of standard units. Create an attractive, *integrated* lighting system through the whole premises, at the same time increase efficiency and lower costs.

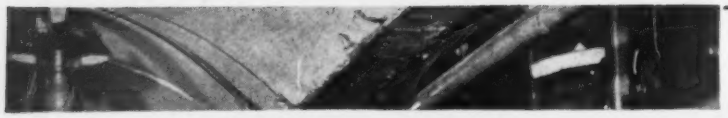
The flexibility of the **atlas atlantic** range extends even further. Alter the functions of floor space at any time, and you need change only reflectors and diffusers to fit the new lighting demands . . . from a robust, functional fitting for stockrooms, to a superb boardroom fitting with decorative diffuser.

The unique features of the chassis, the quality and appearance of the fittings, the high efficiency of the fluorescent light, and the very wide range of units bring you a new concept of low-cost lighting.

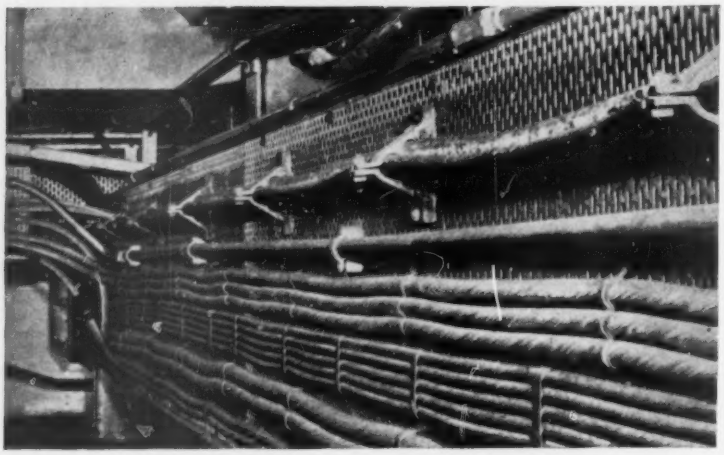
atlas atlantic fittings are available in sizes 8ft., 5ft., and 4ft. with single or double tubes.

atlas atlantic
flexibility in fluorescent lighting

Atlas Lighting Limited, Thorn House, Upper St. Martin's Lane, London WC2



PERFORATED CABLE PLATES . . . in STEEL OR ALUMINIUM ALLOY



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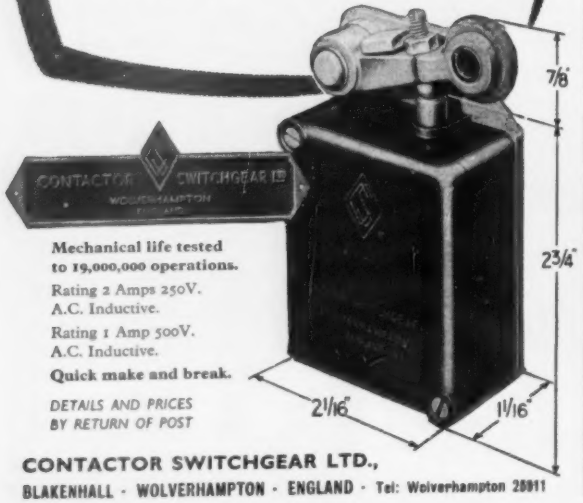
NG 75

MINIATURISED HEAVY DUTY INDUSTRIAL LIMIT SWITCH



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Rating 2 Amps 250V. A.C. Inductive.

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Installations of this type demand a high standard of material. Volex Cables and Electrical Accessories were selected only after very careful consideration because they are known to give effective and trouble-free service.

Note to Electrical Contractors:
If you are tendering for competitive installations, our representative in your area would be pleased to give you details of our products.

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VOLTAGE CONTROL

A range of A.C. Mains Voltage Stabilisers which incorporate electronic detector systems of new design. They are robust, reliable and very compact.
The unit shown has a rating of 2.5 KVA, will handle input variations from 200-250 Volts whilst maintaining a pre-set controlled voltage between 220-240 Volts to an accuracy of ± 0.5%
This particular Stabiliser is suitable for bench, floor or wall mounting and is fitted into a steel case attractively finished in hammered aluminium. Dimensions are : Height 15", Width 10", Depth 7¼".

Torovolts are the new toroidally wound continuously variable auto-transformers. Electrical and mechanical improvements have been incorporated to give greater safety and reliability. Legible dials ensure maximum convenience in use.

Expamet-Cressall resistors, rheostats and heaters form the most comprehensive range available from a single source. Units to control loads from 4 watts to over 20,000 Kilowatts are already in use all over the world. To widen still further the enormous field of applications of Expamet-Cressall products, two new designs have been introduced and are briefly described here. Further details and technical advice from our engineers is freely available.

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Expamet Cressall

The Electrical Division of
The Expanded Metal Company Ltd.

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Works: Stranton Works, West Hartlepool. Tel: Hartlepools 5531
The Cressall Manufacturing Company Ltd., Eclipse Works, Tower Street, Birmingham 19
Tel: Aston Cross 2686

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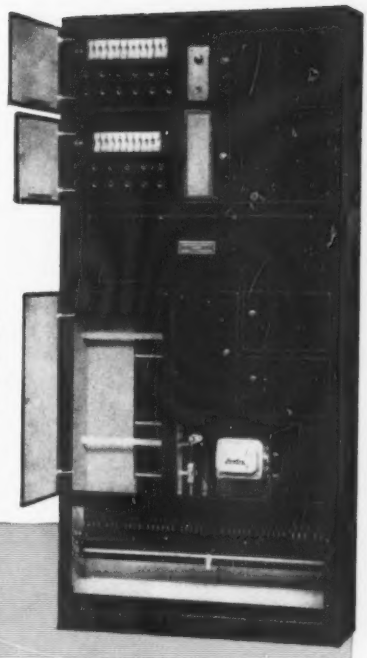
AEROFLEX **Fluvent**

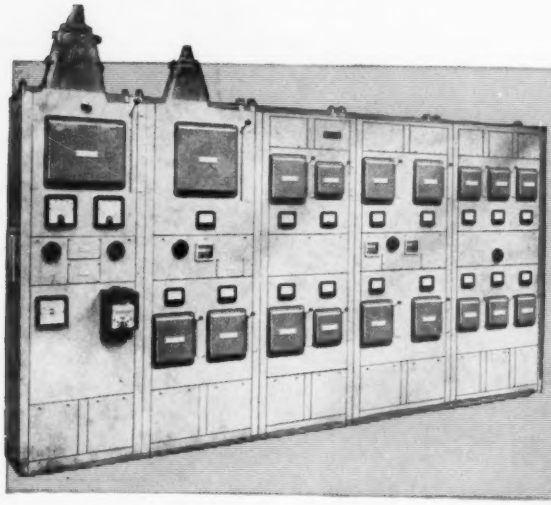
CUBICLE TYPE

SWITCHBOARDS

The name FLUVENT has been associated with advanced Switchboard design since the beginning of the century and the name AEROFLEX has been synonymous with high breaking capacity Fuses since they were first introduced in the early 1920's.

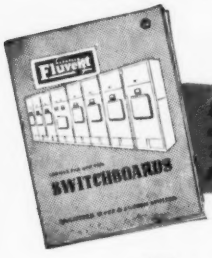


An unusual Cubicle Board (right) which provides a variety of lighting fuseboards with tumbler switch panels. It is installed in St. George's Chapel, Windsor.



Installed in a modern manufacturing undertaking, this Board (above) protects one 300 amp. eight 100 amp. and eight 60 amp. 3 phase 4 wire outgoing circuits, and the incoming Cubicle on the left is provided with a 600 amp. main switch and metering facilities.

A compact Board (right) protecting one 300 amp. and two 60 amp. 3 phase 4 wire circuits and six 30 amp. single phase and neutral circuits, all under the control of a 600 amp. T.P. and Neutral incoming main switch.



Publication SB3 illustrates and describes a selection of Cubicle and Unit Type Switchboards. A copy will be forwarded to you on request.

Parmiter Hope & Sugden Ltd.

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Bulpitt & Sons Ltd., Birmingham 18

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Electrical Groups
and
Subsidiaries

Second Edition 1960

Supplement to 7 January Issue published by
THE ELECTRICAL TIMES
Sardinia House, Sardinia Street, W.C.2

The welcome given to the first edition of this guide to Electrical Groups and Subsidiaries has encouraged us to produce a revised and enlarged edition containing many of the regroupings that have taken place over the past year.

In the following lists, where the group is predominently electrical in character we have endeavoured to include all the subsidiaries, but where the electrical interests are only part of the group's activities, the entries have accordingly been limited. In general, overseas companies have not been included in the index, nor those whose names bear a similarity to those of the parent company.

GUIDE TO TABLES

Where capital is shown it is capital issued

Code W = 90% or more shares owned

C = Over 50% of shares owned

A = Over 30% of shares owned or has working agreement.

Electrical Groups

A1 **Aberdare Holdings Ltd.** £1,299,667
Aberdare Cables Ltd. W
Aberdare Engineering Ltd. W
Ivor Power Specialty Co. Ltd. W
Neckar Water Softener Co. Ltd. W
South Wales Electric (Pty) Ltd. W
South Wales Switchgear Ltd. W

A2 **Aerialite Ltd.** £281,410
D.R. Illuminations Ltd. W
Nettle Accessories Ltd. W
Ryecroft Electric Ltd. W

A3 **Allen West and Co. Ltd.** £2,737,800
Allen West (Canada) Ltd. W
Allenwest Rhod. (Pty) Ltd. W
Allenwest (SA)(Pty) Ltd. W
Reason Manufacturing Co. Ltd. W

A4 **Allied Insulators Ltd.** £1,398,181
Bullers Ltd. W
Electric and Ordnance Accessories Co. Ltd. W
Taylor Tunnicliff and Co. Ltd. W
Taylor Tunnicliff (Refractories) Ltd. W

A5 **Allied Ironfounders Ltd.**
Falco Electrical Appliances Ltd. W
Falkirk Iron Co. Ltd. W
Leisure Kitchen Equipment Ltd. W

A6 **Alwyn Holdings Ltd.**
Rashleigh Phipps Ltd. W

A7 **Arusha Industries Ltd.**
Britannia Engineering Co. W
Grymak Ltd. W
Klaxon Ltd. W

A8 **Ashley Accessories Ltd.**
Astral Switchgear Ltd. W
V.G. Porcelain Co. Ltd. W

A9 **Associated Electrical Industries Limited**
Associated Electrical Industries Estates Ltd. W
Associated Electrical Industries Finance Co. Ltd. W
Associated Electrical Industries Insurance Ltd. W
AEI Divisional Management Co. Ltd. W
Associated Electrical Industries Export Ltd. W
Associadas Eletro-Industriais do Brasil Ltd. W
Associated Electrical Industries (Canada) Ltd. W
Associated Electrical Industries Central Africa (pvt) Ltd. W
Associated Electrical Industries (NZ) Ltd. W
Associated Electrical Industries (Pakistan) Ltd. W
Associated Electrical Industries South Africa (Pty) Ltd. W
Siemens Edison Swan (Canada) Ltd. W
Siemens Edison Swan (Pty) Ltd. W
AEI-John Thompson Nuclear Energy Co. Ltd. C

AEI (Rugby) Group
Associated Electrical Industries (Rugby) Ltd. W
AEI Electronic Apparatus Division
AEI Heavy Plant Division
AEI Motor and Control Gear Division
AEI-Birlec Ltd. W
AEI Lamp and Lighting Co. Ltd. W
AEI Sound Equipment Ltd. W
Birlec-Efco (Melting) Ltd. C
Hill Top Foundry, The, Co. Ltd. C

AEI (Manchester) Group
Associated Electrical Industries (Manchester) Ltd. W
AEI Instrumentation Division
AEI Switchgear Division
AEI Traction Division
AEI Transformer Division
AEI Turbine-Generator Division
Micanite and Insulators, The, Co. Ltd. W
F. F. Chrestien & Co. Ltd. W
Birka Regulator G.m.b.H. W
Société d'Equipment Industriale Electro-Mécanique W
Sunvic Regler G.m.b.H. W

AEI (Woolwich) Group
Associated Electrical Industries (Woolwich) Ltd. W
AEI Cable Division
AEI Construction Division
AEI Radio and Electronic Components Division
AEI Telecommunications Division
Siemens Edison Swan (Australia) Pty. Ltd. W
Aldridge Plastics Ltd. W
Henley Foundries Ltd. W
Multi-Broadcast (Engineering) Ltd. W
Fixed Price Light, The, Co. Ltd.
London Electric Wire Company and Smiths, Ltd. W
Millett, Levens (Engravers) Ltd. W
Printed Circuits Ltd. W
Vactite Wire Company Ltd. W
Lewcos (Australia) Pty. Ltd. W

Overseas Group
Associated Electrical Industries Overseas Ltd. W
AEI Limited C
Australian Electrical Industries Pty. Ltd. C
Arrow Switches (Australia) Pty. Ltd. C
Hard Metals Pty. Ltd. C

A9 **Associated Electrical Industries Ltd.**—*Cont.*
Ediswan-Ekco (C.R.T.) Co. Pty. Ltd. C
Associated Electrical Industries (India) Pvt. Ltd. W
Associated Electrical Industries Mfg. Co. Pvt. Ltd. W
Hotpoint Group
AEI-Hotpoint Ltd. W
AEI-Gala Ltd. W
Associated Companies
Battery Carbons Ltd. A
British Sealed Beams Ltd. A
Ediswan-Ekco (Aust.) Pty. Ltd. A
Fairfield Electric Wire Co. Pty. Ltd. A
First Electric Corporation of South Africa Ltd. A
Glass Bulbs Ltd. A
Henley-Simplex Africa (Pty.) Ltd. A
Isotope Developments Ltd. A
Lamp Caps Ltd. A
Metro-Cutanit Ltd. A
Metropolitan-Vickers-Beyer, Peacock Ltd. A
Nuclear Graphite Ltd. A
Siemens & General Electric Railway Signal Co. Ltd. A
Southern United Telephone Cables Ltd. A
Submarine Cables Ltd. A
Telephone Manufacturers of South Africa (Pty.) Ltd. A

A10 **Automatic Telephone and Electric Co. Ltd.**
Associated Transistors Ltd. A
A.T. and E. (Bridgnorth) Ltd. W
A.T. and E. (Wigan) Ltd. W
Birkbys Ltd. A
British Telecommunications Research Ltd. A
Communication Systems Ltd. W
Enfield Tool Manufacturing Co. Ltd. C
Hivac Ltd. W
Precision Engineering Products (Suffolk) Ltd. C
A.T.E. de Venezuela S.A., W
A.T.E. Telefones Automoticos do Brasil S.A. W
Automatica Electrica Portuguesa, S.A.R.L. W
Automatic Telephone and Electric Co. (East Africa) Ltd. W
Automatic Telephone and Electric Co. (New Zealand) Ltd. W
Automatic Telephone and Electric Co. (India) Private Ltd. W
Automatic Telephones (S.A.) Ltd. W
British Automatic Telephone and Electric Pty Ltd. Australia W
Communication Systems of Australia Pty Ltd. W
Communication Systems of South Africa (Pty) Ltd. W
Telefones Automaticos e Equipmento Electrico Ltda., Brazil W
Telefonos Automaticos y Productos Electricos S.A. Argentine W
Telephone Manufacturers of South Africa (Pty) Ltd. A

Barton and Sons Ltd. **£2,109,069** **B1**
Barton Conduits Ltd. W
Rev Motors Ltd. W

Belmos Co. Ltd., The **£323,923** **B2**
Everett Edgcumbe Ltd. W

Bowthorpe Holdings Ltd. **£1,000,000** **B3**
Bowthorpe Electric Co. Ltd. W
Bowthorpe Engineering Co. Ltd. W
Hellermann (Canada) Ltd. W
Hellermann Corporation (USA) C
Hellermann Ltd. W
Line Equipment Ltd. C
Paul Hellermann G.m.b.H. W
Tate Engineers Ltd. C

Braby, Fred., and Co. Ltd. **B4**
Auto Diesels Ltd. W
Diesel Equipment Ltd. W
Norman and Industrial Marine Co. Ltd. W

Britannia Electric Lamp Works Ltd. **£175,000** **B5**
Gnome Electric Lamp Works, The, Ltd. W
Noma Electric Co. Ltd. C

British Electric Resistance Co. Ltd. **£200,000** **B6**
Australian and NZ Elect. Ind. (Pty) Ltd. W
British Power Transformer Co. Ltd. W
Electric Products Ltd. W
International Power Transformers Ltd. W

British Insulated Callender's Cables Ltd. **£21,325,436** **B7**
Bartles (Carn Breur) Ltd. A
British Copper Refiners Ltd. W
British Dielectric Research Ltd. W
British Insulated Callender's Construction Co. Ltd. W
British Telecommunications Research Ltd. A
Conollys Blackley Ltd. C
Magnetic and Electrical Alloys Ltd. W
MSS Recording Co. Ltd. C
Painter Bros. Ltd. W
Panelec (GB) Ltd. W
Phillips Electrical Co. Ltd. C
Rotunda Ltd. W
Scottish Cables Ltd. W
Selborne Plantation Co. Ltd. W
St. Helens Cable and Rubber Co. Ltd. C
Submarine Cables Ltd. A
Telcon-Magnetic Cores Ltd. C
Telecommunications Cables Pty Ltd. A
Telegraph Condenser Co. Ltd. W
Telegraph Construction and Maintenance Co. Ltd. W
Temco Ltd. C
Toolpro Ltd. W
Thomas Bolton and Sons Ltd. C
United Capacitor Co. (Pty) Ltd. W
United Insulator Co. Ltd. C
W. T. Glover and Co. Ltd. W
BICC Construction (NZ) Ltd. W
British Insulated Callender's Cables (Aust) Pty Ltd. C
British Insulated Callender's Cables (SA) Ltd. W

Indian Cable Co. Ltd. A
Industria Venezolana de Cables Electricos A
Insulated Wires (Aust) Pty Ltd. A
Malayan Cables Ltd. A
Rhodesian Cables Ltd. C
Telcon Enterprises Overseas Ltd. W
Telcon (Pakistan) Ltd. A
Telcon (Aust) Pty Ltd. W
Telcon Africa (Pty) Ltd. W

B8 British Thermostat Co. Ltd. £1,060,000
P. W. Baker and Sons Ltd. W
P. W. Baker and Sons (Sales) Ltd. W
Societe Francaise des Thermostats S.A. W
Teddington Aircraft Controls Ltd. W
Teddington (Holland) N.V. W
Teddington Industrial Equipment Ltd. W
Teddington Refrigeration Controls Ltd. W

B9 British Vacuum Cleaner and Eng. Co. Ltd. £750,000
New name to be Goblin (B.V.C.) Ltd.
British Capeheart Corpn. Ltd. W
BVC Electronic Developments Ltd. W
BVC Industries (NI) Ltd. W
Goblin (African) (Pty) Ltd. W
Goblin Electric Appliances Ltd. W
Goblin Electric Cleaner Co. Ltd. (Canada) W
Magneta Time Co. Ltd. W

B10 Brook Motors Ltd. £1,062,461
Brook Electric Motors (Canada) W
Brook Motor Corpn. (Florida) W
Brook Motors Corpn. (USA) W

B11 Bucknall, Henry, and Sons Ltd.
Control Heating Units (London) Ltd. W
R. E. Thompson and Co. (Sunbury) Ltd. W

B12 Burco Dean Ltd. £868,750
Burco Ltd. W
G. L. Howarth and Co. Ltd. W
Nadex Ltd. W
Panette Holloware Ltd. W
Thomas Ashworth and Co. Ltd. W
W. H. Dean and Son Ltd. W

B13 Burgess Products Co. Ltd. £450,000
Burgess G.m.b.H. W

B14 Bylock Electric Ltd. £135,000
Bylock Distributors Ltd. W
CCA (Vacuum Cleaners) Ltd. W

C1 Camp Bird Ltd.
Ambassador Radio and TV Ltd. A
A. Prince Industrial Products Ltd. W
Baldwin Central Products Ltd. W
Baldwin Engineering Equipment Ltd. W
Baldwin Durawire Cable Co. Ltd. A
Coolers and Venders Ltd. W
Creston Electric Ltd. W
Duratube and Wire Ltd. C
Electronic Reproducers Ltd. W
Electronic Reproducers (Components) Ltd. W
Hartley Electromotives Ltd. C
Hartley Electromotives (East Africa) Ltd. C
Hartley Installations Ltd. C
Hartley Robertson Ltd. A
H. J. Baldwin of Canada Ltd. C
Kelly Acoustics Ltd. W
Limit Engineering Group Ltd. and subsidiaries W
Rowe Automatic Merchandising Co. Ltd. A
Ster-O-Matic Inc. (USA) C
Vending Supply and Service Ltd. W

Chloride Electric Storage Co. Ltd. £6,594,218 C2
Alkaline Batteries Ltd. C
Alklum Storage Batteries Ltd. C
Britannia Batteries Ltd. C
Chloride Batteries Ltd. W
D.P. Battery Co. Ltd. W
Ferrostatics Ltd. W
Holsun Batteries Ltd. W
Hymatic Engineering Co. Ltd. W
Patterson Lamps (1953) Ltd. C
Pritchett and Gold and EPS Co. Ltd. W
Rozalex Ltd. W
Shires and Co. (London) Ltd. W
Tudor Accumulator Co. Ltd. W
United Ebonite and Lorival Ltd. W

Clydesdale Supply Co. Ltd. £816,667 C3
B. M. Levine Ltd. W
Carrick Trust Ltd. W
Clydesdale Television & Radio Co. Ltd. W
Clydesdale Rentals Ltd. W
Electrical Ohms Ltd. W
Jas. Allan & Co. (Aberdeen) Ltd. W
James Allan (Glasgow) Ltd. W
McGulloch & Young Ltd. W
Ronald Mason Ltd. W
Rowland Ltd. W
Tec Ltd. W

Cole, E. K., Ltd. £1,272,630 C4
American Tradair Corpn. (New York) W
Commercial Facilities Ltd. W
Dynatron Radio Ltd. W
Ediswan-Ekco (Aust) Pty Ltd. A
Egen Electric Ltd. W
Ekco Electronics Ltd. W
E. K. Cole (Colombia) Ltd. A
Ekco-Ensign Electric Ltd. A
Ekco Plastics Ltd. W
Ferranti Radio and Television Ltd. W
Kelly and Shiel (Ekco Prod.) Ltd. (Dublin) A
Kruger-Wilson Africa Ltd. A
Maldon Woodwork Ltd. A
National Ekco Radio and Eng. Co. Ltd. A
Twentieth Century Electronics Ltd. A
Ultimate-Ekco (NZ) Co. Ltd. (Auckland) A
V. C. Bond and Sons Ltd. A
Warm-Glow Co. Ltd. W

Concentric Manufacturing Co. Ltd. C5
Alexander Controls Ltd. W

C6 **Cossor, A. C., Ltd.** **£1,500,000**
Beam Instruments Corpn. Inc. USA W
Best Products Ltd. W
Cossor Communications Co. Ltd. W
Cossor Instruments Ltd. W
Cossor Radar and Electronics Ltd. W
Cossor Valve Co. Ltd. W
E.M.I.-Cossor Electronics Ltd. (Canada) A
Floyd and Partners (Cables) Ltd. W
Plastic Tubes and Conduit Co. Ltd. W
Sterling Cable Co. Ltd. W
Sterling Cables (Canada) Ltd. W

C7 **Crabtree Electrical Industries Ltd.** **£950,000**
J. A. Crabtree and Co. Ltd. W
J. A. Crabtree (Pty) Ltd. (SA) W
C. M. Churchouse Ltd. W
Robbins and Bradley Ltd. W

C8 **Crittall, Richard, and Co. Ltd.** **£525,000**
Abbey Heating Co. Ltd. W
Grierson Ltd. W
Magnetic Valve Co. Ltd. A
Richard Crittall Marine Ltd. W
Thermic Heating Co. Ltd. W
Thomas McDowell Ltd. W

C9 **Crompton Parkinson Ltd.** **£6,476,751**
A. E. Morrison and Sons Ltd. A
Atomic Power Constructions Ltd. A
Austin-Crompton Parkinson Electric Vehicles Ltd. A
Bepco Canada Ltd. A
British Electric Transformer Co. Ltd. W
B. and S. Electrical Pty Ltd. W
Cooke and Ferguson Ltd. W
Crompton Parkinson (Aust) Pty Ltd W
Crompton Parkinson (Central Africa) Ltd. W
Crompton Parkinson (Chelmsford) Ltd. W
Crompton Parkinson (Doncaster) Ltd. W
Crompton Parkinson Electrical Ltd. W
Crompton Engineering Co. (Madras) Ltd. A
Crompton Parkinson (NZ) Ltd. W
Crompton Parkinson (South Africa) (Pty) Ltd. W
Crompton Parkinson (Stud Welding) Ltd. W
Crompton Parkinson (Works) Pvt Ltd. (of India) A
Derby Cables Ltd. W
Electricars Ltd. A
F. and A. Parkinson Ltd. W
Greaves Cotton and Crompton Parkinson Pvt Ltd. (of India) A
Greaves Crompton Parkinson Ltd. (of Pakistan) A
I.T.D. Ltd. A
L. Clarke and Co. Ltd. W
Noyes (Aust) Pty Ltd. A
Young Accumulator Co. Ltd. W

D1 **Deritend Group**
E. J. Wilcock Ltd. W
Midland Electric Installation Co. Ltd. W
Shoolbread Electrical Co. Ltd. W

D2 **Dorman Smith Holdings Ltd.** **£350,000**
Alorite Ltd. W
British Klockner Switchgear Ltd. W
Dorman and Smith Ltd. W
Dorman and Smith (Domestic) Ltd. W
D.S. Plugs Ltd. W
Hindustan Klockner Switchgear Ltd. A
John Booth Foundries Ltd. W

Drake and Gorham Ltd. **£225,000** **D3**
Drake and Gorham (Contractors) Ltd. W
Ottermill Switchgear Ltd. W

Dubilier Condenser Co. (1925) Ltd. **£423,269** **D4**
Isenthal and Co. Ltd. W
Mansbridge Condenser Co. Ltd. W

Duport Ltd. **D5**
Revo Electric Co. Ltd. W

Edmundson's Electric Co. Ltd. **E1**
Edmundson's Electrical Wholesalers Ltd. W
Electro Mechanical Supplies Ltd. W
W. H. Stone and Co. (Cardiff) Ltd. W
F. Westerman (Wholesale) Ltd. W
West Wales Trading Co. (Milford Haven) Ltd. W
T. Beadle & Co. Ltd. W

Efco Ltd. **£572,790** **E2**
Efco-Industrieofen A.G. C
Efco (SA) (Pty) Ltd. C
Electric Furnace Co. Ltd. W
Electric Resistance Furnace Co. Ltd. W
Electro Chemical Eng. Co. Ltd. W
Royce Electric Furnaces Ltd. W

Electric and Musical Industries Ltd. **£7,234,000** **E3**
EMI Electronics Ltd. W
EMI Sales and Service Ltd. W
Gramophone Co. Ltd. W

Electric Construction Co. Ltd. **£1,138,498** **E4**
ECC (Canada) Ltd. A
ECC Holdings (Pty) Ltd. W
ECC Ltd. (NZ) A
ECC (Moulded Breakers) Ltd. A
ECC (South Africa) (Pty) Ltd. C
Electric Construction Co. (Small Motors) Ltd. W
Tyseley Foundry Ltd. W

Electrical Apparatus Co. Ltd. **£648,212** **E5**
Bray, Markham and Reiss Ltd. W
Claytat Ltd. W

Electrical Components (Holdings) Ltd. **£1,021,905** **E6**
Electrical Components Ltd. W
F. D. Newcombe and Co. Ltd. W
Flinders (Wholesale) Ltd. W
J. F. Irvine and Co. Ltd. W
Santon (Wholesale) Ltd. W

Electro-Hydraulics Ltd. **E7**
Conveyancer Fork Trucks Ltd. W
Scott Electric Vehicles Ltd. W

E8 **Elliott-Automation Ltd.** £3,679,440
Associated Automation Ltd. W
B. and P. Swift Ltd. W
Bristol's Instrument Co. Ltd. W
C. P. Clare Ltd. W
Electroflo Meters Co. Ltd. W
Elliott-Automation AG (Zurich) W
Elliott Brothers (London) Ltd. W
Elliott Brothers Sales Agencies Ltd. W
Elliott Nucleonics Ltd. W
Farris Engineering Ltd. W
Fisher Governor Co. Ltd. W
Gilmoor Control Systems Ltd. W
Hall Telephone Accessories Ltd. W
James Gordon and Co. Ltd. W
James Gordon Valves Ltd. W
Mechanical Automation Ltd. W
National Automatic Machines Ltd. W
Panellit Ltd. W
Rotameter Manufacturing Co. Ltd. W
Sauter Controls Ltd. W
Swift and Swallow Ltd. W
Swartwout Co. Ltd. W
Swartwout N.V. W
Webb Conveyors and Automation Ltd. W

E9 **Elliott, B., Ltd.** £100
Adams Bros. and Burnley Ltd. W
Elliott Domestic Appliances Ltd. W
Mastermet Ltd. W

E10 **Enfield Rolling Mills Limited**
Aston Chain & Hook Co. Ltd. W
Barker & Allen W
Enfield Cables Ltd. W
Enfield Cables (Aust) Pty Ltd. W
Enfield Cables (E. Africa) Ltd. W
Enfield Cables (NZ) Ltd. W
Enfield Cables (Rhodesia) Ltd. W
Enfield Cables (SA) (Pty) Ltd. W
Enfield-Standard Power Cables Ltd. A
English Salvi Co. Ltd. W
W. E. Martin & Co. Ltd. W
Refrigeration Appliances Ltd. W
Watliff Co. Ltd. W

E11 **The English Electric Co. Ltd.** £32,774,850
Associated Transistors Ltd. A
Canadian Marconi Company C
Canmar Investment Co. Ltd. W
Companhia Marconi Brasiliera C
Dick Kerr and Co. Ltd. W
D. Napier & Son (Canada) Ltd. C
D. Napier & Son Ltd. C
Emerson Radio of Canada Ltd. C
English Electric Aviation Ltd. W
English Electric Export and Trading Co. Ltd. W
English Electric Valve Co. Ltd. W
John Inglis Co. Ltd. C
Marconi (China) Ltd. W
Marconi Instruments Ltd. W
Marconi International Code Co. Ltd. W
Marconi International Marine Communication Co. Ltd. W
The Marconi Sounding Device Co. Ltd. A
The Marconi Television Co. Ltd. W
Marconi Wireless Telegraph Co. Ltd. W
Napier Engineering, Inc. C
Phoenix Dynamo Manufacturing Co. Ltd. W
Robert Stephenson and Hawthorns Ltd. W
Scanners Ltd. W
The Vulcan Foundry Ltd. W
Willans and Robinson Ltd. W
Svenska Radio Atkiebolaget C
English Electric, Babcock & Wilcox and Taylor Woodrow Atomic Power Construction Co. Ltd. A
The English Electric Co. of Australia Pty Ltd. W
The English Electric Co. of Canada Ltd. C
The English Electric Co. (Central Africa) (Private) Ltd. W
The English Electric Co. of India (Private) Ltd. W
The English Electric Co. of New Zealand Ltd. W
The English Electric Co. of South Africa (Pty) Ltd. W
English Electric de Venezuela C.A. W
English Electric Espanola S.A. W
Establecimentos Argentinos Marconi W
Marconi de Venezuela C.A. W
Marconi Italiana S.p.A. C
Marconi (South Africa) Ltd. W

E12 **Eugene Ltd.**
Suter Electrical Engineering Co. Ltd. C

E13 **Ever Ready Co. (Great Britain) The, Ltd.** £5,252,010
Berec Radio Ltd. W
Berec (Europe) Ltd. W
Berec (International) Ltd. W
Ceramic Eng. Co. Ltd. W
Chemical and Carbon Products Ltd. W
Daimon G.m.b.H. W
Everedy South Africa Ltd. A
Ever Ready Radio Valve Co. Ltd. W
Grosvenor Electric Batteries Ltd. W
Vince's Dry Batteries Ltd. W

E14 **Evershed and Vignoles Ltd.**
Record Electrical Co. Ltd. W
Tinsley (Electrical Instruments) Ltd. W

E15 **E.V. Industrials Ltd.**
Furse Wholesale Ltd. W
W. J. Furse & Co. Ltd. W
W. J. Furse & Co. (London) Ltd. W
W. J. Furse & Co. (Manchester) Ltd. W

E16 **Expanded Metal Co. Ltd.**
Cressall Mfg. Co. Ltd. W

E17 **Ether Langham Thompson Ltd.**
Ether Ltd. W
J. Langham Thompson Group Ltd. W

F1 **Falk, Stadelmann and Co. Ltd.** £1,664,625
Falks, Electrical (SA) (Pty) Ltd. W
Falks (NZ) Ltd. C
Ionlite Ltd. C
Irish Cables Ltd. W
Lighting Trades & Welsbach Ltd. W

F1 **Falk, Stadelmann and Co. Ltd.**—*Cont.*

Raydex Ltd.	W
Smith and Ansell Ltd.	W
Stoves Ltd.	W
Switchgear Equipment Ltd.	C
United Electrical Co. Ltd.	W
Veritas Heating Products Ltd.	W
Wandleside Cable Works Ltd.	W
Wandleside Warren Wire Co. Ltd.	A

F2 **Fenner, J. H., and Co. (Holdings) Ltd.**

NGN Electrical Ltd.	W

F3 **Firth Cleveland Ltd.**

Broadmead Ltd.	W
Civic Radio Services Ltd.	W
Escott Brothers Ltd.	W
Firth Cleveland Instruments Ltd.	W
Max-Stone Ltd.	W
Stenor Ltd.	W

GI **Gas Purification and Chemical Co. Ltd.**

AB Metal Products Ltd.	W
B & R Relays Ltd.	W
E. G. Irwin & Partners Ltd.	W
Grundig (Great Britain) Ltd.	W
Johnson British Electric Ltd.	W
Kingsway of London Ltd.	W
Smart & Brown (Machine Tools) Ltd.	W
Staar Electronics Ltd.	W
Wolsey Electronics Ltd.	W

G2 **General Cable Mfg. Co. Ltd.** **£280,000**
Controlled by F. McNeill and Co. Ltd.

Britannic Cables Ltd.	W

G3 **General Electric Co. Ltd.** **£23,600,000**

Agricultural Supplies (Cambridge) Ltd.	C
Battery Carbons Ltd.	A
Branch Properties Ltd.	W
Bushing Co. Ltd.	A
Chamberlain and Hookham Ltd.	W
Claude-General Neon Lights Ltd.	C
Coldair Ltd.	W
Columbian-General Blacks Ltd.	A
Computer Developments Ltd.	A
Cryselco Ltd.	A
Express Lift Co. Ltd.	W
Evenlite Tube Lamp Developments Ltd.	A
G.E.C. Lighting Equipment Ltd.	W
Glass Bulbs Ltd.	A
GPA Tools and Gauges Ltd.	W
Lamp Caps Ltd.	A
Lumifax Ltd.	C
Machlett X-Ray Tubes (GB) Ltd.	W
M-O Valve Co. Ltd.	W
Oriental Tube Co. Ltd.	W
Parkhall Pottery Co. Ltd.	W
Pirelli-General Cable Works Ltd.	A
Pope's Electric Lamp Co. Ltd.	W
Progressive Electrics Ltd.	W
Reliance Telephone Co. Ltd.	W
J. T. Rothwell and Co. Ltd.	W
Salford Electrical Instruments Ltd.	W
Siemens and General Electric Railway Signal Co. Ltd.	A
Simplex Dairy Equipment Co. Ltd.	C
Telephone Supplies Ltd.	W
Watson and Sons (Electro-Medical) Ltd.	C
Witton-James Ltd.	W
Woods of Colchester Ltd.	C
Amalgamated Electric Corpn. Ltd. (Canada)	W
Anglo Argentine GEC Ltd.	W
British GEC (Japan) Ltd.	W
British GEC Pty Ltd. (Australia)	W
British GEC (Canadian) Ltd.	W
British GEC of Central Africa (Pty) Ltd.	W
British GEC Ltd. (China)	W
British GEC Ltd. (NZ)	W
British GEC (Pty) Ltd. (SA)	W
Collier and Beale Ltd. (NZ)	C
Express Lift Co. (SA) (Pty) Ltd.	W
Fraser and Chalmers of Canada Ltd.	W
GEC of Burma Ltd.	W
GEC of East Africa Ltd.	W
GEC of Ghana Ltd.	W
GEC of Nigeria Ltd.	W
GEC of Trinidad Ltd.	W
GEC of India Pvt. Ltd.	W
GEC of India (Mfg) Pvt Ltd.	W
GEC Overseas Services Ltd.	W
GEC Iranian Technical Services Ltd.	W
GEC (Malaya) Ltd.	W
GEC Overseas Services Ltd.	W
GEC of Pakistan Ltd.	W
Premier Lift and Escalator Co. (Pty) Ltd.	W

Grelco Ltd. **G4**

C. E. Sleeper Ltd.	W

Hackbridge and Hewittic Electric Co. Ltd. **£1,350,000** **H1**

Hackbridge Electric Construction Co. Ltd.	W
Hackbridge and Hewittic Electric Co. Canada Ltd.	W
Hackbridge Hewittic Transformers and Rectifiers (Pty) Ltd. (SA)	W
Kartnet Switchgear Co. Ltd.	W
New Switchgear Construction Co. Ltd.	W

Hackbridge Holdings Ltd. **£900,000** **H2**

Bryce Elect. Const. Co. Ltd.	W
Bryce Ltd.	W
Hackbridge Cable Co. Ltd.	W
Kelvin Non-Ferrous Metal Co. Ltd.	W
London Transformer and Production Ltd.	W
Mitcham Motor Co. Ltd.	W
Siemens Schuckert (GB) Ltd.	W

Harland Engineering Co. Ltd. **£800,000** **H3**

Bepco Canada Ltd.	A
Harland Drives Ltd.	W
Harland Engineering (Aust) Pty Ltd.	A
Simon Equipment Ltd.	W
Vivian Harland Eng. Co. (Pty) Ltd.	A

Harper Engineering and Electronics Ltd. **H4**

Baldwin Instrument Co. Ltd.	W
Electrical Screw Ltd.	W
Stanley Eng. Co. Ltd.	W
Sidney Hole's Electric Vehicles Ltd.	W

H5 **Harris and Sheldon (Holdings) Ltd.**
Harris and Sheldon (Electrical) Ltd. W
Midland Coil Winding Co. Ltd. W

H6 **Hawker Siddeley Industries Ltd.**
Bryce Berger Ltd. W
Brush Electrical Engineering Co. Ltd. W
Fuller Electric Ltd. W
Hawker Siddeley Brush Turbines Ltd. W
Hawker Siddeley (Hamble) Ltd. W
Mirlees Bickerton and Day Ltd. W
National Gas and Oil Engine Co. Ltd. W
Petters Co. Ltd. W

H7 **Hoover Ltd.** **£3,050,007**
Controlled by Hoover Co. (USA)
Hoover (Elect. Motors) Ltd. W
Hoover (Washing Machines) Ltd. W
Perivale Motors Ltd. W

H8 **Hopkinsons Ltd.**
Fielden Electronics Ltd. C

I1 **Ideal Building and Land Development Co. Ltd.**
Reliance Electrical Co. Ltd. W

I2 **Incandescent Heat, The, Co. Ltd.**
Metalectric Furnaces Ltd. W

J1 **Johnson and Phillips Ltd.** **£2,917,187**
Aurora Lamps Ltd. W
British National Electrics Ltd. W
Chapelhall Cables Ltd. A
Johnson and Phillips (Aust) Pty Ltd. W
Johnson and Phillips SA (Pty) Ltd. W
Johnson and Phillips Transformers (Pty) Ltd. C

K1 **Keith Prowse and Co. Ltd.**
John E. Dallas and Sons C

K2 **Kenwood Manufacturing Co. Ltd.**
Dishmaster (London) Ltd. C
Kenwood Electrics Ltd. W
Mayfair Engineers and Platers Ltd. W
Kenwood G.m.b.H. W
Kenwood Mfg. (Aust) Pty Ltd. W
(Association with Peerless and Ericsson Ltd. from 1st January).

K3 **K.G. (Holdings) Ltd.** **£232,500**
E. Wight and Co. (Muswell Hill) Ltd. W
F. H. Wheeler (Bristol) Ltd. W
F. H. Wheeler and Co. Ltd. W
F. H. Wheeler (Southern) Ltd. W
Perihel Ltd. W
Tellux Ltd. W
W.S. Electronics (Extruders) Ltd. W
W.S. Electronics (Prod.) Ltd. W

L1 **Lancashire Dynamo Holdings Ltd.** **£3,465,268**
African Electrical Man. Pty Ltd. A
Bepco Canada Ltd. A
Cable Jointers Ltd. W
Crypto Ltd. W
Crypton Equipment Ltd. W
Dynamic and Motor Repairs Ltd. W
Foster Electrical Supplies Ltd. W
Foster Transformers Ltd. W
International Rectifier Co. (GB) Ltd. A
J. G. Statter and Co. Ltd. W
Lancashire Dynamo C.A. (Pty) Ltd. W
Lancashire Dynamo and Crypto Ltd. W
Lancashire Dynamo Electronic Prod. Ltd. W
Lancashire Dynamo Group Sales Ltd. W
Lancashire Dynamo Nevelin Ltd. W
Lancashire Dynamo S.A. (Pty) Ltd. W
Malcom and Allan (London) Ltd. W
Minerva Mouldings Ltd. W

Laurence, Scott and Electromotors Ltd. **£1,676,530** **L2**
Enclosed Motor Co. Ltd. W
Printing and Paper Drives Ltd. C
Tri-Com Patents Ltd. W
Walter McGee and Son Ltd. W

Lloyds Packing Warehouses (Holdings) Ltd. **L3**
Argosy Radiovision Ltd. W
Combined Radio and Television Services Ltd. W
Lloyds (Manchester) Elec. Industries Ltd. W
Radio Gramophone Dev. Co. Ltd. W
Regentone Products Ltd. W
Regentone Radio and Television Ltd. W
United Components Ltd. W

London Brick Co. Ltd. **L4**
Transformers (Watford) Ltd. C

Mann, Egerton and Co. Ltd. **M1**
Botwoods Ltd. W
Mann, Egerton Electronics Ltd. W
Mann, Egerton Finance Ltd. W
W. H. Johnson and Sons Ltd. W

Marryat and Scott Holdings Ltd. **£300,000** **M2**
Austin Lifts Ltd. W
GMP Ltd. A
John Bennie Ltd. W
Marris's (Engs.) Ltd. W
Marryat and Place Ltd. W
Marryat and Scott Ltd. W
Marryat's East Africa Ltd. W
Waring, Withers and Chadwick Ltd. C

Metal Industries Ltd. **M3**
Avo Ltd. W
Brookhirst Igranic Ltd. W
Brookhirst Igranic (Europe) SA W
Brookhirst Switchgear Ltd. W
Cantie Switches Ltd. W
Igranic Electric Co. Ltd. W
Igranic Electric SA (Pty) Ltd. W
Taylor Electrical Instruments Ltd. W

Midland Electric Manufacturing Co. Ltd. **£1,575,000** **M4**
J. H. Tucker and Co. Ltd. W
Kersons Mfg. Co. Ltd. W

Morphy Richards Ltd. **£845,028** **M5**
Astral Equipment Ltd. W
Eureka Ltd. W
Maybaum Richards Verkaufs G.m.b.H. W

M5 **Morphy Richards**—*Cont.*
Morphy Richards (Aust) Pty Ltd. C
Morphy Richards Argentina SA A
Morphy Richards (Canada) Ltd. W
Morphy Richards Inc. (US) W
Morphy Richards (Pty) Ltd. W
Morphy-Richards (Nederland) N.V. W
MR Salgsorganisation A/S (Denmark) W
Yelsen Ltd. W

M6 **Mossley Blanket and Carpet Co. (Holdings) Ltd.**
Permaheat (Mossley) Ltd. W

N1 **Newman Industries Ltd.** **£387,422**
Newman Industries (Aust) Pty Ltd. W
Newman Electric Motors Inc. W

P1 **Parkinson Cowan Ltd.**
Measurement Eng. Ltd. (NZ) W
Measurement Ltd. W
Parkinson Cowan Appliances Ltd. W
Parkinson Cowan Instruments (Division) W

P2 **Parmiter, Hope and Sugden Ltd.**
J. F. Collier and Co. Ltd. W

P3 **Parsons, C. A., and Co. Ltd.** **£9,600,000**
Anglo-Great Lakes Corpn. Ltd. A
C. A. Parsons of Australia Ltd. W
C. A. Parsons of Canada Ltd. W
C. A. Parsons and Co. Rhodesia Pvt Ltd. W
C. A. Parsons and Co. (SA) (Pty) Ltd. W
Nuclear Power Plant Co. Ltd. A
Parolle Electric Plant Co. Ltd. A
Sir Howard Grubb Parsons and Co. Ltd. W

P4 **Philips Electrical Industries Ltd.**
(*Controlled by Philips Incandescent Lamp Works, Eindhoven*)
Cossor Radio and Television Ltd. W
Mullard Ltd. W
Philips Electrical Ltd. W
Stella Lamp Co. Ltd. W
Stella Radio and Television Co. Ltd. W

P5 **Phoenix Telephone and Electric Holdings Ltd.** **£458,570**
B.O.B. (Arundel) Ltd. W
Correx Communication Equip. (1948) Ltd. W
Phoenix Appliances Ltd. W
Phoenix Internal Telephones Systems Ltd. W
Phoenix (The) Telephone and Elect. Works Ltd. W
Private Telephone and Electric Co. Ltd. W
Rotosigns Ltd. W

P6 **Plessey, The, Co. Ltd.**
Amar Tool and Gauge Co. Ltd. W
Cottage Laboratories Ltd. W
Ketay Ltd. C
Machine Products Ltd. W
Plessey Co. of Canada Ltd. W
Plessey Inc. W
Plessey International Ltd. W
Plessey (Northern Ireland) Ltd. W
Plessey Nucleonics Ltd. W
Plessey Research Ltd. W
Power Auxiliaries Ltd. C
Preformations Ltd. C
Rosite Ltd. C
Semiconductors Ltd. C
Technical Ceramics Ltd. C
The Plessey Development Co. Ltd. W
Wireless Telephone Co. Ltd. W

Power Securities Corporation **£2,500,000** **P7**
Balfour Beatty and Co. Ltd. W
Balfour Beatty and Co. (Canada) Ltd. W
Balfour Beatty (Overseas) Ltd. W
Duncan Watson (Elec. Eng.) Ltd. W
James Kilpatrick and Son Ltd. W
Metropolitan Contruction Co. Ltd. W
Murdoch and Brooks Ltd. (Iraq) W
Russell Construction Ltd. (Canada) W
Tersons Ltd. W

Pullin, R. B., and Co. Ltd. **£682,300** **P8**
Aldis Brothers Ltd. W
Donvin Instruments Ltd. W
Measuring Instruments (Pullin) Ltd. W
Milbo Photographic Ltd. W
Neville Brown & Co. Ltd. W
Pullin Optical Co. Ltd. W
Stanley Cox Ltd. W
Victoria Instruments Ltd. W

Pye Ltd. **£6,927,167** **P9**
Cathodeon Crystals Ltd. W
Cathodeon Ltd. W
Corron Works Ltd. W
Faraday Electronics Instruments Ltd. W
Graseby Instrument Ltd. W
Holloway Eng. Works, Ltd. W
Invictor Radio Ltd. W
Labgear Ltd. W
L. G. Hawkins and Co. Ltd. W
Lindley Thompson Transformer & Services Co. Ltd. W
Magnetic Devices Ltd. W
Pamphonic Reproducers Ltd. W
Pam (Rad. and Tele.) Ltd. W
Pye Industrial Electronics Ltd. C
Pye Marine Ltd. W
Pye Telecommunications Ltd. W
Pye Industries (Aust) Ltd. A
TV Manfg. Ltd. W
Unicam Instruments Ltd. W
United Rentals Ltd. W
Woodcroft Productions (Cambridge) Ltd. W
W. Watson and Sons Ltd. W

Radiation Ltd. **R1**
Ascot Lamps and Lighting Ltd. W
Electrical Division of Radiation Ltd. W
Jackson Industries Ltd. W
Parnall (Yate) Ltd. W
Thor Appliances Ltd. W

Rawlplug Co. Ltd. **£575,000** **R2**
Automatic Controls Ltd. W
Rawlplug Products (Canada) Ltd. W

R3	**Reliance-Clifton Cables and Industrial Products Ltd.**	**£745,190**	
	Clifton Securities Co. Ltd.	W	
	Patent Lighting Co. Ltd.	W	
	Reliance Cords and Cables Ltd.	W	
R4	**Reyrolle, A., and Co. Ltd.**	**£5,481,911**	
	A. Reyrolle and Co. (Rhodesia) Ltd.	W	
	A. Reyrolle and Co. SA (Pty) Ltd.	W	
	British Short Circuit Testing Station Ltd.	W	
	Bushing Co. Ltd.	C	
	C. A. Parsons and Co. Ltd.	A	
	J. H. Holmes and Co. Ltd.	W	
	Parolle Electric Plant Co. Ltd.	A	
	A. Reyrolle & Co. (NZ) Ltd.	W	
R5	**Rheostatic Co. Ltd.**	**£889,200**	
	Contactor (Pty) Ltd.	W	
	Satchwell Controls (Canada) Ltd.	C	
	Societe Anonyme la Thermostatique	C	
R6	**Richardsons, Westgarth and Co. Ltd.**	**£5,910,876**	
	Atomic Power Constructions Ltd.	A	
	Geo. Clarke and N. E. Marine (Sunderland) Ltd.	W	
	North-Eastern Marine Eng. Co. Ltd.	W	
	Parsons Marine Turbine Co. Ltd.	W	
	Richardsons, Westgarth Atomic Ltd.	W	
	Richards, Westgarth (Hartlepool) Ltd.	W	
	Humber Graving Dock & Eng. Co. Ltd.	W	
R7	**Riley and Neate Ltd.**	**£40,000**	
	Preformed Line Materials (Great Britain) Ltd.	W	
S1	**Scott, James, and Co. (Elect. Eng.) Ltd.**	**£456,327**	
	Clyde Eng. and Equipment Co. Ltd.	W	
	Malcolm and Allan Ltd.	W	
S2	**Simm's Motor and Electronics Corpn. Ltd.**	**£2,271,530**	
	Aircraft Steel Structures Ltd.	W	
	A. R. Parsons and Co. Ltd.	W	
	British Centralab Ltd.	W	
	British Vacuum Flask Co. Ltd.	W	
	Clearex Products Ltd.	W	
	Hadrill and Horstmann Ltd.	W	
	Horstman Ltd.	W	
	Industrial Fan and Heater Co. Ltd.	W	
	Lester Plastics Ltd.	W	
	London Colney Service Station (1947) Ltd.	W	
	M.E.C. Coolants Ltd.	W	
	M.E.C. Transmissions Ltd.	W	
	Mono Cam Ltd.	W	
	N.S.F. Ltd.	W	
	Remax Ltd.	W	
	R.F. Landon and Partners Ltd.	W	
	Simplus Products Ltd.	W	
	Simm's Motor Units Ltd.	W	
	Thompson Manufacturing Co. Ltd.	W	
S3	**Smith, S., and Sons (England) Ltd.**		
	Kelvin and Hughes Ltd.	C	
	Smith's Aircraft Instruments Ltd.	W	
	Smith's Industrial Instruments Ltd.	W	
S4	**Southern Areas Electrical Corpn. Ltd.**	**£783,484**	
	Carrick Eng. (Stewarton) Ltd.	W	
	Designs and Installations Ltd.	W	
	Globelite Industries Ltd.	W	
	Mawdsley's Ltd.	W	
	New Day Electric (Sales) Ltd.	W	
	Resoid Ltd.	W	
	Ross, Courtney and Co. Ltd.	W	
	Tyer and Co. Ltd.	W	
S5	**Stanhay (Ashford) Ltd.**		
	Ray Electricals (Folkestone) Ltd.	W	
S6	**Standard Telephones and Cables Ltd.**		
	Controlled by International Standard Electric Corporation		
	Kolster-Brandes Ltd.	W	
	Enfield-Standard Power Cables Ltd.	A	
S7	**Sterling Electric Holdings Ltd.**	**£260,000**	
	Electrix Ltd.	W	
	Russell Newbury & Co. Ltd.	W	
	Sterling Engineering Co. Ltd.	W	
	Sterling Incandescent Co. Ltd.	W	
S8	**Stone, J. and F. Lighting and Radio Ltd.**	**£1,200,000**	
	Bookers Lighting and Radio Ltd.	W	
	Chain Store Finance Trust Ltd.	W	
	District Supplies Ltd.	W	
	Dynaport Radio & Television Ltd.	W	
	F. W. Allen (Bristol) Ltd.	W	
	S. Gray and Co. (1939) Ltd.	W	
S9	**Stone Platt Industries Ltd.**		
	Austinlite Ltd.	W	
	Chance Londex	W	
	Epsylon Industries Ltd.	C	
	Sumo Pumps Ltd.	W	
S10	**Strand Electric Holdings Ltd.**	**£172,500**	
	Strand Electric and Engineering Co. Ltd.	W	
	Implitico Ltd.	W	
	Tyler and Feeman Ltd.	W	
	Strand Electric (Australia) Pty. Ltd.	W	
S11	**Switchgear and Cowans Ltd.**	**£450,000**	
	Eastnor Electric Co. Ltd.	W	
	Harvey and Longstaffe Ltd.	W	
	Richard Whiffen Ltd.	W	
	Sykes and Harrison Ltd.	W	
T1	**Telephone Manufacturing Co. Ltd.**	**£900,000**	
	Carrington Mfg. Co. Ltd.	C	
	Hollingsworth Printing Co. Ltd.	W	
	T.M.C. Harwell (Sales) Ltd.	W	
T2	**Thorn Electrical Industries Ltd.**	**£2,994,375**	
	African Lamps Pty Ltd.	C	
	Atlas Lighting Ltd.	W	
	Austin Clarke (London) Ltd.	W	
	Beam-Echo Ltd.	W	
	British Radio Corpn. Ltd.	C	
	Champion Electric Corpn.	W	
	Deutsche Atlas G.m.b.H.	W	
	Ekco Ensign Electric Ltd.	C	

T2 **Thorn Electrical Industries Ltd.**—*Cont.*

Elgar Research Laboratories Ltd. A
Ensign Lamps (Aust) Pty Ltd. W
Evansville Cabinet Co. Ltd. W
Ferguson Radio Corpn. Ltd. W
F. H. Marshall and Co. Ltd. W
Geo. Forrest and Son Ltd. W
Lamp Presscaps Ltd. W
Manifold Machinery Co. Ltd. W
Nash and Thompson Ltd. W
Newhaven Cabinet Works Ltd. W
N. Herrmann Ltd. W
Philco GB Ltd. W
Philco (Overseas) Ltd. W
Smart and Brown (Eng.) Ltd. W
Sylvania Thorn Colour Television Labs. Ltd. A
Talent European Co. Ltd. W
Talent Furniture Ltd. W
Thorn Elect. Ind. (Aust) Pty Ltd. W
Thorn Electrical Ind. (NZ) Ltd. W
Thorn Electrical Ind (SA) Pty Ltd. W
Thorn Electro Industries AG W
Tricity Cookers Ltd. W
Tricity Finance Corporation Ltd. A

T3 **Tilling, Thomas, Ltd.**
Newey and Eyre Ltd. C

Truvox Holdings Ltd. **T4**
Airmec Ltd. W
British Communications Corpn. Ltd. W
Radio and Television Trust Ltd. W
Rola Celestion Ltd. W
Truvox Engineering Co. Ltd. W
Truvox Ltd. W
Thermionic Products (Electronics) Ltd. W

Tube Investments Ltd, **T5**
Electrical Division
A. P. Lundberg and Sons W
Mersey Cable Works Ltd. W
Metallic Seamless Tube Co. Ltd. W
Power Centre Co. Ltd. W
Simplex Electric Co. Ltd. W

Unidare Ltd. **£1,000,000** **UI**
Irish Overseas Ltd. W
Unidare Eng. Ltd. W

United Molasses Co. Ltd. **U2**
E. N. Bray Ltd. W

Venner Ltd. **£354,000** **VI**
Venner Accumulators Ltd. W
Venner Electronics Ltd. W
Venner Time Switches Ltd. W

Worcester Royal Porcelain, The, Co. Ltd. **WI**
Welwyn Electrical Laboratories Ltd. W

Index to Subsidiaries

Where the name of a subsidiary clearly reflects that of the parent company, it has not been indexed. This particularly applies with overseas companies.

Abbey Heating Co. Ltd. C7
Aberdare Cables Ltd. A1
Aberdare Engineering Ltd. A1
AB Metal Products Ltd. G1
Adams Brothers and Burnley Ltd. E9
Agricultural Supplies (Cambridge) Ltd. G3
Aircraft Steel Structures Ltd. S2
Airmec Ltd. T4
Aldis Brothers Ltd. P8
Aldridge Plastics Ltd. A9
Alexander Controls Ltd. C5
Alkaline Batteries Ltd. C2
Alklum Storage Batteries Ltd. C2
Allan, Jas., and Co. (Aberdeen) Ltd. C3
Allen, F. W. (Bristol) Ltd. S8
Alorite Ltd. D2
Amar Tool and Gauge Co. Ltd. P6
Ambassador Radio and Television Ltd. C1
Anglo-Great Lakes Corpn. Ltd. P3
Argosy Radiovision Ltd. L3
Ascot Lamps and Lighting Ltd. R1
Ashworth, Thomas, and Co. Ltd. B12
Associated Automation Ltd. E8
Associated Transistors Ltd. A10, E11
Aston Chain and Hook Co. Ltd. E10
Astral Equipment Ltd. M5
Astral Switchgear Ltd. A8
Atlas Lamps Pty Ltd. T2
Atomic Power Constructions Ltd. C9, R6
Aurora Lamps Ltd. J1
Austin Clarke (London) Ltd. T2
Austin Lifts Ltd. M2
Austinlite Ltd. S9
Auto Diesels Ltd. B4
Automatic Controls Ltd. R2
Avo Ltd. M3

B. and R. Relays Ltd. G1
B. and S. Electrical Pty Ltd. C9
Baker, P. W., and Sons Ltd. B8
Baldwin Central Products Ltd. C1
Baldwin Durawire Cable Co. Ltd. C1
Baldwin Engineering Equipment Ltd. C1
Baldwin Instrument Co. Ltd. H4
Balfour Beatty and Co. Ltd. P7
Barker and Allen Ltd. E10
Barton Conduits Ltd. B1
Battery Carbons Ltd. A9 G3
Beadle, T. & Co. Ltd. E1
Beam-Echo Ltd. T2
Bennie, John, Ltd. M2
Bepco Canada Ltd. C9 H3 L1
Berec Radio Ltd. E13
Best Products Ltd. C6

Birkleys Ltd. A10
Birlec-Efco (Melting) Ltd. A9
B.O.B. (Arundel) Ltd. P5
Bolton, Thomas, and Sons Ltd. B7
Bond, V. C., and Sons Ltd. C4
Bookers Lighting and Radio Ltd. S8
Booth, John, Foundries Ltd. D2
Botwoods Ltd. M1
Branch Properties Ltd. G3
Bray, E. N., Ltd. U2
Bray, Markham and Reiss Ltd. E5
Bristol's Instrument Co. Ltd. E8
Britannia Batteries Ltd. C2
Britannia Engineering Co. A7
Britannic Cables Ltd. G2
British Capeheart Corpn. Ltd. B9
British Centralab Ltd. S2
British Communications Corporation Ltd. T4
British Copper Refiners Ltd. B7
British Dielectric Research Ltd. B7
British Electric Transformer Co. Ltd. C9
British Klockner Switchgear Ltd. D2
British National Electrics Ltd. J1
British Power Transformer Co. Ltd. B6
British Radio Corporation Ltd. T2
British Sealed Beams Ltd. A9
British Short Circuit Testing Station Ltd. R4
British Telecommunications Research Ltd. A10 B7
British Vacuum Flask Co. Ltd. S2
Brookhirst Igranic Ltd. M3
Broadmead Ltd. F3
Brown, Neville, and Co. Ltd. P8
Brush Electrical Engineering Co. Ltd. H6
Bryce Berger Ltd. H6
Bryce Electric Construction Co. Ltd. H2
Bryce Ltd. H2
Bullers Ltd. A4
Burco Ltd. B12
Burgess Products Co. Ltd. B13
Bushing Co. Ltd. G3 R4
BVC Electronic Developments Ltd. B9

CCA (Vacuum Cleaners) Ltd. B14
Cable Jointers Ltd. L1
Canmar Investment Co. Ltd. E11
Cantie Switches Ltd. M3
Carrick Eng. (Stewarton) Ltd. S4
Carrick Trust Ltd. C3
Carrington Manufacturing Co. Ltd. T1
Cathodeon Crystals Ltd. P9
Cathodeon Ltd. P9
Ceramic Engineering Co. Ltd. E13
Chain Store Finance Trust Ltd. S8
Chamberlain and Hookham Ltd. G3
Champion Electric Corporation T2
Chance Londex S9
Chapelhall Cables Ltd. J1
Chemical and Carbon Products Ltd. E13
Chloride Batteries Ltd. C2
Christien, F. F., and Co. Ltd. A9
Churchouse, C. M., Ltd. C7
Civic Radio Services Ltd. F3
Clare, C. P., Ltd. E8
Clarke, Geo., and N. E. Marine (Sunderland) Ltd. R6
Clarke, L., and Co. Ltd. C9
Claude-General Neon Lights Ltd. G3
Claytat Ltd. E5
Clearex Products Ltd. S2
Clifton Securities Co. Ltd. R3
Clyde Eng. and Equipment Co. Ltd. S1
Clydesdale Rentals Ltd. C3
Clydesdale Television and Radio Ltd. C3
Coldair Ltd. G3
Collier, J. F., and Co. Ltd. P2
Columbian-General Blacks Ltd. G3
Combined Radio and Television Services Ltd. L3
Commerical Facilities Ltd. C4
Communication Systems Ltd. A10
Computer Developments Ltd. G3
Contactor (Pty) Ltd. R5
Control Heating Units (London) Ltd. B11
Conveyancer Fork Trucks Ltd. E7
Cooke and Ferguson Ltd. C9
Coolers and Venders Ltd. C1
Correx Communication Equipment (1948) Ltd. P5
Corron Ltd. P9
Cossor Communications Co. Ltd. C6
Cossor Instruments Ltd. C6
Cossor Radar and Electronics Ltd. C6
Cossor Radio and Television Ltd. P4
Cossor Valve Co. Ltd. C6
Cottage Laboratories Ltd. P6
Cox, Stanley, Ltd. P8
Crabtree, J. A., and Co. Ltd. C7
Cressall Manufacturing Co. Ltd. E16
Creston Electric Ltd. C1
Crypto Ltd. L1
Crypton Equipment Ltd. L1
Cryselco Ltd. G3

D. R. Illuminations Ltd. A2
D. S. Plugs Ltd. D2
Dallas, John E., and Sons K1
Dean, W. H., and Son Ltd. B12
Derby Cables Ltd. C9
Designs and Installations Ltd. S4
Diesel Equipment Ltd. B4
Dishmaster (London) Ltd. K2
District Supplies Ltd. S8
Donvin Instruments Ltd. P8
D. P. Battery Co. Ltd., The C2
Duncan Watson (Elec. Eng.) Ltd. P7
Duratube and Wire Ltd. C1
Dynamic and Motor Repairs Ltd. L1
Dynaport Radio and Television Ltd. S8
Dynatron Radio Ltd. C4

Eastnor Electric Co. Ltd. S11
Egen Electric Ltd. C4
Ekco Ensign Electric Ltd. C4 T2
Electric Furnace Co. Ltd. E2
Electric and Ordnance Accessories Co. Ltd. A4
Electric Products Ltd. B6
Electric Resistance Furnace Co. Ltd. E2
Electrical Ohms Ltd. C3
Electrical Screw Ltd. H4
Electricars Ltd. C9
Electrix Ltd. S7
Electro Chemical Engineering Co. Ltd. E2
Electroflo Meters Co. Ltd. E8
Electro Mechanical Supplies Ltd. E1

Electronic Reproducers Ltd. C1
Elgar Research Laboratories Ltd. T2
Elliott Brothers (London) Ltd. E8
Elliott Domestic Appliances Ltd. E9
Elliott Nucleonics Ltd. E8
Enclosed Motor Co. Ltd. L2
Enfield Cables Ltd. E10
Enfield-Standard Power Cables Ltd. E10 S6
Enfield Tool Manufacturing Co. Ltd. A10
English Salvi Co. Ltd. E10
Epsylon Industries Ltd. S9
Escott Brothers Ltd. F3
Eureka Ltd. M5
Evansville Cabinet Co. Ltd. T2
Evenlite Tube Lamp Developments Ltd. G3
Everett Edgcumbe Ltd. B2
Express Lift Co. Ltd. G3

Falco Electrical Appliances Ltd. A5
Falkirk Iron Co. Ltd. A5
Faraday Electronic Instruments Ltd. P9
Farris Engineering Ltd. E8
Ferguson Radio Corporation Ltd. T2
Ferranti Radio and Television Ltd. C4
Ferrostatics Ltd. C2
Fielden Electronics Ltd. H8
Fisher Governor Co. Ltd. E8
Fixed Price Light Co. Ltd., The A9
Flinders (Wholesale) Ltd. E6
Floyd and Partners (Cables) Ltd. C6
Forrest, Geo., and Son Ltd. T2
Foster Electrical Supplies Ltd. L1
Foster Transformers Ltd. L1
Fuller Electric Ltd. H6
Furse Wholesale Ltd. E15
Furse, W. J., and Co. Ltd. E15

Gilmoor Control Systems Ltd. E8
Glass Bulbs Ltd. A9 G3
Globelite Industries Ltd. S4
Glover, W. T., and Co. Ltd. B7
GMP Ltd. M2
Gnome Electric Lamp Works Ltd., The B5
Goblin Electric Appliances Ltd. B9
Gordon, James, and Co. Ltd. E8
GPA Tools and Gauges Ltd. G3
Gramophone Co. Ltd. E3
Graseby Instruments Ltd. P9
Gray, S., and Co. (1939) Ltd. S8
Grierson Ltd. C7
Grosvenor Electric Batteries Ltd. E13
Grundig (Great Britain) Ltd. G1
Grymak Ltd. A7

Hackbridge Cable Co. Ltd. H2
Hackbridge Electric Construction Co. Ltd. H1
Hadrill and Horstmann Ltd. S2
Hall Telephone Accessories Ltd. E8
Harland Drives Ltd. H3
Hartley Electromotives Ltd. C1
Hartley Installations Ltd. C1
Harvey and Longstaffe Ltd. S11
Hawkins, L. G., and Co. Ltd. P9
Hellermann Ltd. B3
Henley Foundries Ltd. A9
Herrmann, N., Ltd. T2
Hill Top Foundry Co. Ltd., The A9
Hivac Ltd. A10
Holes, Sidney, Electric Vehicles Ltd. H4
Hollingsworth Printing Co. Ltd. T1
Holloway Eng. Works Ltd. P9
Holmes, J. H., and Co. Ltd. R4
Holsun Batteries Ltd. C2
Horstman Ltd. S2
Howarth, G. L., and Co. Ltd. B12
Humber Graving Dock and Engineering Co. Ltd. R6
Hymatic Engineering Co. Ltd. C2

Implitico Ltd. S10
Industrial Fan and Heater Co. Ltd. S2
International Power Transformers Ltd. B6
International Rectifier Co. (GB) Ltd. L1
Invictor Radio Ltd. P9
Ionlite Ltd. F1
Irish Cables Ltd. F1
Irvine, J. F., and Co. Ltd. E6
Irwin and Partners, E. G., Ltd. G1
Isenthal and Co. Ltd. D4
Isotope Developments Ltd. A9
Ivor Power Speciality Co. Ltd. A1

Jackson Industries Ltd. R1
Johnson British Electric Ltd. G1
Johnson, W. H., and Sons Ltd. M1

Kartret Switchgear Co. Ltd. H1
Kelly Acoustics Ltd. C1
Kelvin and Hughes Ltd. S3
Kelvin Non-Ferrous Metal Co. Ltd. H2
Kerr, Dick, and Co. Ltd. E11
Kersons Manufacturing Co. Ltd. M4
Ketay Ltd. P6
Kilpatrick, James, and Son Ltd. P7
Kingsway of London Ltd. G1
Klaxon Ltd. A7
Kolster-Brandes Ltd. S6

Labgear Ltd. P9
Lamp Caps Ltd. A9 G3
Lamp Presscaps Ltd. T2
Landon, R. F., and Partners Ltd. S2
Langham Thompson, J., Group Ltd. E17
Leisure Kitchen Equipment Ltd. A5
Lester Plastics Ltd. S2
Levine, B. M., Ltd. C3
Lighting Trades and Welsbach Ltd. F1
Limit Engineering Group Ltd. C1
Lindley Thompson Transformers and Services Co. Ltd. P9
Line Equipment Ltd. B3
Lloyds (Manchester) Electrical Industries Ltd. L3
London Colney Service Station (1947) Ltd. S2
London Electric Wire Company and Smiths Ltd., The, A9
London Transformer and Production Ltd. H2
L.T.D. Ltd. C9
Lumifax Ltd. G3

Machine Products Ltd. P6
Machlett X-Ray Tubes (GB) Ltd. G3
Magnetic Devices Ltd. P9
Magnetic and Electrical Alloys Ltd. B7

Magneta Time Co. Ltd. B9
Magnetic Valve Co. Ltd. C8
Malcolm and Allan (London) Ltd. L1
Malcolm and Allan Ltd. S1
Maldon Woodwork Ltd. C4
Manifold Machinery Co. Ltd. T2
Mansbridge Condenser Co. Ltd. D4
Marconi Instruments Ltd. E11
Marris's (Engs.) Ltd. M2
Marryat and Place Ltd. M2
Marshall, F. H., and Co. Ltd. T2
Martin, W. E., and Co. Ltd. E10
Mason, Ronald, Ltd. C3
Mastermet Ltd. E9
Mawdsley's Ltd. S4
Mayfair Engineers and Platers Ltd. K2
McDowell, Thomas, Ltd. C7
McGee, Walter, and Son Ltd. L2
McGulloch and Young Ltd. C3
Measurement Ltd. P1
Measuring Instruments (Pullin) Ltd. P8
MEC Coolants Ltd. S2
Mechanical Automation Ltd. E8
MEC Transmissions Ltd. S2
Metalectric Furnaces Ltd. I2
Metro-Cutanit Ltd. A9
Metropolitan Construction Co. Ltd. P7
Metropolitan-Vickers-Beyer, Peacock Ltd. A9
Max-Stone Ltd. F3
Micanite and Insulators Co. Ltd., The A9
Midland Coil Winding Co. Ltd. H5
Midland Electrical Installations Co. Ltd. D1
Milbo Photographic Ltd. P8
Millett, Levens (Engravers) Ltd. A9
Minerva Mouldings Ltd. L1
Mirlees Bickerton and Day Ltd. H6
Mitcham Motor Co. Ltd. H2
Mono-Cam Ltd. S2
Morrison, A. E., and Sons Ltd. C9
M-O Valve Co. Ltd. G3
MSS Recording Co. Ltd. B7
Mullard Ltd. P4
Multi-Broadcast (Engineering) Ltd. A9

Nadex Ltd. B12
Napier, D., and Son Ltd. E11
Nash and Thompson Ltd. T2
National Automatic Machines Ltd. E8
National Gas and Oil Engines Co. Ltd. H6
Neckar Water Softener Co. Ltd. A1
Nettle Accessories Ltd. A2
Newcombe, F. D., and Co. Ltd. E6
New Day Electric (Sales) Ltd. S4
Newey and Eyre Ltd. T3
Newhaven Cabinet Works Ltd. T2
Newman Industries Ltd. N1
New Switchgear Construction Co. Ltd. H1
NGN Electrical Ltd. F2
Noma Electric Co. Ltd. B5
Norman and Industrial Marine Co. Ltd. B4
North-Eastern Marine Engineering Co. Ltd. R6
NSF Ltd. S1
Nuclear Graphite Ltd. A9
Nuclear Power Plant Co. Ltd. P3

Oriental Tube Co. Ltd. G3
Ottermill Switchgear Ltd. D3

Painter Brothers Ltd. B7
Pamphonic Reproducers Ltd. P9
Pam (Radio and Television) Ltd. P9
Panelec (GB) Ltd. B7
Panellit Ltd. E8
Panette Holloware Ltd. B12
Parkhall Pottery Co. Ltd. G3
Parkinson, F. and A., Ltd. C9
Parnall (Yate) Ltd. R1
Parolle Electric Plant Co. Ltd. P3 R4
Parsons, A. R., and Co. Ltd. S2
Parsons, C. A., and Co. Ltd. R4
Parsons Marine Turbine Co. Ltd. R6
Parsons, Sir Howard Grubb, and Co. Ltd. P3
Patent Lighting Co. Ltd. R3
Patterson Lamps (1953) Ltd. C2
Perihel Ltd. K3
Perivale Motors Ltd. H7
Permaheat (Mossley) Ltd. M6
Petters Co. Ltd. H6
Philco (Great Britain) Ltd. T2
Phillips Electrical Co. Ltd. B7
Phoenix Appliances Ltd. P5
Phoenix Dynamo Manufacturing Co. Ltd. E11
Pirelli-General Cable Works Ltd. G3
Plastic Tubes and Conduit Co. Ltd. C6
Pope's Electric Lamp Co. Ltd. G3
Power Auxiliaries Ltd. P6
Precision Engineering Products (Suffolk) Ltd. A10
Preformations Ltd. P6
Preformed Line Materials (Great Britain) Ltd. R7
Prince, A., Industrial Products Ltd. C1
Printed Circuits Ltd. A9
Printing and Paper Drives Ltd. L2
Pritchett and Gold and EPS Co. Ltd. C2
Private Telephone and Electric Co. Ltd. P5
Progressive Electrics Ltd. G3
Pullin Optical Co. Ltd. P8

Radio Gramophone Development Co. Ltd. L3
Radio and Television Trust Ltd. T4
Rashleigh Phipps Ltd. A6
Raydex Ltd. F1
Ray Electricals (Folkestone) Ltd. S5
Reason Manufacturing Co. Ltd. A3
Record Electrical Co. Ltd. E14
Refrigeration Appliances Ltd. E10
Regentone Products Ltd. L3
Reliance Cords and Cables Ltd. R3
Reliance Electrical Co. Ltd. I1
Reliance Telephone Co. Ltd. G3
Remax Ltd. S2
Resoid Ltd. S4
Rev Motors Ltd. B1
Revo Electric Co. Ltd. D5
Robbins and Bradley Ltd. C7
Rola Celestion Ltd. T4
Rosite Ltd. P6
Ross, Courtney and Co. Ltd. S4
Rotameter Manufacturing Co. Ltd. E8
Rothwell, J. T., and Co. Ltd. G3
Rotosigns Ltd. P5

Rotunda Ltd. B7
Rowe Automatic Merchandising Co. Ltd. C1
Rowland Ltd. C3
Royce Electric Furnaces Ltd. E2
Rozalex Ltd. C2
Russell, Newbury and Co. Ltd. S7
Rycroft Electric Ltd. A2

Salford Electrical Instruments Ltd. G3
Santon (Wholesale) Ltd. E6
Sauter Controls Ltd. E8
Scanners Ltd. E11
Scott Electric Vehicles Ltd. E7
Scottish Cables Ltd. B7
Selborne Plantation Co. Ltd. B7
Semiconductors Ltd. P6
Shires and Co. (London) Ltd. C2
Shoolbred Electrical Co. Ltd. D1
Siemens and General Electric Railway Signal Co. Ltd. A9 G3
Siemens Schuckert (GB) Ltd. H2
Simon Equipment Ltd. H3
Simplex Dairy Equipment Co. Ltd. G3
Simplus Products Ltd. S2
Sleeper, C. E., Ltd. G4
Smart and Brown (Engineers) Ltd. T2
Smart and Brown (Machine Tools) Ltd. G1
Smith and Ansell Ltd. F1
Smith's Aircraft Instruments Ltd. S3
Smith's Industrial Instruments Ltd. S3
South Wales Electric (Pty) Ltd. A1
South Wales Switchgear Ltd. A1
Southern United Telephone Cables Ltd. A9
Staar Electronics Ltd. G1
Stanley Engineering Co. Ltd. H4
Statter, J. G., and Co. Ltd. L1
Stella Lamp Co. Ltd. P4
Stella Radio and Television Co. Ltd. P4
Stenor Ltd. F3
Stephenson, Robert, and HawthornsLtd. E11
Sterling Cables Ltd. C6
Sterling Engineering Co. Ltd. S7
Sterling Incandescent Ltd. S7
St. Helens Cable and Rubber Co. Ltd. B7
Stone, W. H., and Co. (Cardiff) Ltd. E1
Stoves Ltd. F1
Submarine Cables Ltd. A9 B7
Sumo Pumps Ltd. S9
Suter Electrical Engineering Co. Ltd. E12
Swartwout Co. Ltd. E8
Swift, B. and P., Ltd. E8
Swift and Swallow Ltd. E8
Switchgear Equipment Ltd. F1
Sykes and Harrison Ltd. S11
Sylvania Thorn Colour Television Labs. Ltd. T2

Talent European Co. Ltd. T2
Talent Furniture Ltd. T2
Tate Engineers Ltd. B3
Taylor Electrical Instruments Ltd. M3
Taylor Tunnicliffe and Co. Ltd. A4
Tec Ltd. C3
Technical Ceramics Ltd. P6
Teddington Aircraft Controls Ltd. B8
Teddington Industrial Equipment Ltd. B8
Teddington Refrigeration Controls Ltd. B8
Telcon-Magnetic Cores Ltd. B7
Telegraph Condenser Co. Ltd. B7
Telegraph Construction and Maintenance Co. Ltd. B7
Telephone Supplies Ltd. G3
Tellux Ltd. K3
Temco Ltd. B7
Tersons Ltd. P7
Thermic Heating Co. Ltd. C7
Thermionic Products (Electronics) Ltd. T4
Thompson Manufacturing Co. Ltd. S2
Thompson, R. E., and Co. (Sunbury) Ltd. B11
Thor Appliances Ltd. R1
Tinsley (Electrical Instruments) Ltd. E14
T.M.C. Harwell (Sales) Ltd. T1
Toolpro Ltd. B7
Transformers (Watford) Ltd. L4
Tri-Cam Patents Ltd. L2
Tricity Cookers Ltd. T2
Tricity Finance Corporation Ltd. T2
Tucker, J. H., and Co. Ltd. M4
Tudor Accumulator Co. Ltd. C2
TV Manufacturing Ltd. P9
Twentieth Century Electronics Ltd. C4
Tyer and Co. Ltd. S4
Tyler and Freeman Ltd. S10
Tyseley Foundry Ltd. E4

Unicam Instruments Ltd. P9
Unidare Engineering Ltd. U1
United Components Ltd. L3
United Ebonite and Lorival Ltd. C2
United Electrical Co. Ltd. F1
United Insulator Co. Ltd. B7
United Rentals Ltd. P9

Vactite Wire Co. Ltd. A9
Vending Supply and Service Ltd. C1
Venner Ltd. V1
Veritas Heating Products Ltd. F1
VG Porcelain Co. Ltd. A8
Victoria Instruments Ltd. P8
Vince's Dry Batteries Ltd. E13
Vulcan Foundry Ltd., The E11

Wandleside Cable Works Ltd. F1
Wandleside Warren Wire Co. Ltd. F1
Waring, Withers and Chadwick Ltd. M2
Warm-Glow Co. Ltd. C4
Watliff Co. Ltd. E10
Watson and Sons (Electro-Medical) Ltd. G3
Watson, W., and Sons Ltd. P9
Webb Conveyors and Automation Ltd. E8
Welwyn Electrical Laboratories Ltd. W1
Westerman (Wholesale) Ltd. E1
West Wales Trading Co. (Milford Haven) Ltd. E1
Wheeler, F. H. K3
Whiffen, Richard, Ltd. S11
Wight, E., and Co. (Muswell Hill) Ltd. K3
Wilcock, E. J., Ltd. D1
Willans and Robinson Ltd. E11
Wireless Telephone Co. Ltd. P6
Witton-James Ltd. G3
Wolsey Electronics Ltd. G1
Woodcraft Productions (Cambridge) Ltd. P9
Woods of Colchester Ltd. G3
W. S. Electronics K3

Yelsen Ltd. M5
Young Accumulator Co. Ltd. C9